# Ecological Risk Assessment
# Residual Risk Assessment
# Willamette Cove Upland Facility

**January 2014**

*Prepared for:*

**Apex Companies, LLC**
3015 SW First Avenue
Portland, OR 97201

*and*

**Port of Portland**
7200 N.E. Airport Way
Portland, OR 97218

*Prepared by:*

**Formation Environmental, LLC**
2500 55th Street, Suite 200
Boulder, Colorado 80301

# TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF TABLES (Continued)

## LIST OF FIGURES

## LIST OF APPENDICES (CD-ROM)

## LIST OF APPENDICES (Continued)

## LIST OF APPENDICES (Continued)

## LIST OF APPENDICES (Continued)

## LIST OF ACRONYMS

| | |
|---|---|
| 90UCL | 90$^{th}$ percentile Upper Confidence Limit |
| µm | Micrometer |
| µg/dL | Microgram per deciliter |
| ac | Acre |
| ACA | Ash Creek Associates |
| Apex | Apex Companies, LLC |
| amsl | Above mean sea level |
| AOCs | Areas of Concern |
| ARLs | Acceptable Risk Levels |
| AST | Aboveground Storage Tank |
| BBL | Blasland, Bouck & Lee, Inc. |
| BERA | Baseline Ecological Risk Assessment |
| bgs | below ground surface |
| BHHRA | Baseline Human Health Risk Assessment |
| BNSF | Burlington Northern Santa Fe |
| BRA | Baseline Risk Assessment |
| BW | Body weight |
| CA | Contaminated Area |
| COIs | Chemicals of Interest |
| CPD | Commission of Public Docks |
| CPECs | Contaminants of Potential Ecological Concern |
| CRA | Comprehensive Risk Assessment |
| CSM | Conceptual Site Model |
| DEQ | Department of Environmental Quality |
| DU | Decision Units |
| EBV | Ecological Benchmark Value |
| EcoSSL | Ecological Soil Screening Level |
| ECSI | Environmental Cleanup Site Information |
| EPA | United States Environmental Protection Agency |
| EPCs | Exposure Point Concentrations |
| ERA | Ecological Risk Assessment |
| ESLs | Ecological Screening Levels |
| EU | Exposure Unit |
| FE | Formation Environmental, LLC |
| FS | Feasibility Study |
| ft | Feet |
| g/day | Grams per day |
| ha | Hectare |
| HEAST | Health Effects Assessment Summary Tables |
| HPAHs | High Molecular Weight Polynuclear Aromatic Hydrocarbons |
| IEUBK | Integrated Exposure Uptake Biokinetic |
| IH | Heavy Industrial |
| LC50 | Median lethal concentration |
| LD50 | Median lethal dose |
| LOAEL | Lowest-observed-adverse-effect-level |
| LWG | Lower Willamette Group |
| MDCs | Maximum Detected Concentrations |

## LIST OF ACRONYMS (CONTINUED)

| | |
|---|---|
| mg/kg | Milligram per kilogram |
| mg/dL | Milligram per deciliter |
| mg/L | Milligram per liter |
| MHWM | Mean High Water Mark |
| MRL | Maximum Reporting Limit |
| NF | NewFields |
| NGVD29 | National Geodetic Vertical Datum of 1929 |
| NOAEL | No-observed-adverse-effects-level |
| OAR | Oregon Administrative Rule |
| OLLW | Ordinary Line of Low Water |
| ORNHIC | Oregon Natural Heritage Information Center |
| ORNL | Oak Ridge National Laboratories |
| OS | Open Space |
| PAHs | Polynuclear Aromatic Hydrocarbons |
| PCBs | Polychlorinated Biphenyls |
| PCDD/Fs | Polychlorinated Dibenzodioxins and Dibenzofurans |
| PDC | Portland Development Commission |
| PMC | Portland Manufacturing Company |
| PRGs | Preliminary Remediation Goals |
| RERA | Residual Ecological Risk Assessment |
| RI | Remedial Investigation |
| RAA | Removal Action Area |
| SCE | Source Control Evaluation |
| SLVs | Screening Level Values |
| SOW | Scope of Work |
| SVOCs | Semivolatile Organic Compounds |
| T/E | Threatened and Endangered |
| TMDP | Technical-Management Decision Point |
| TPHs | Total Petroleum Hydrocarbons |
| TRVs | Toxicity Reference Values |
| TQ | Toxicity Quotient |
| UPRR | Union Pacific Railroad |
| USDOE | U.S. Department of Energy |
| USTs | Underground Storage Tanks |
| VCP | Voluntary Cleanup Program |
| VOCs | Volatile Organic Compounds |

# 1.0 INTRODUCTION

This document presents the residual ecological risk assessment (RERA) for the Willamette Cove Upland Facility (Facility). This document is a supplemental evaluation to the Ecological Risk Assessment portion of the Baseline Risk Assessment (BRA) that was conducted in 2007 (NewFields/Ash Creek Associates [NF/ACA] 2007). The BRA included analysis of risk for human health and ecological receptors at the Facility. This document does not contain evaluation of human health but is being submitted in conjunction with a Residual Human Health Risk Assessment (RHHRA) (Formation Environmental [FE]/ACA, submitted February 2013). The requirement and scope for the RERA are based on comments from Oregon Department of Environmental Quality's (DEQ) reassessment of the BERA (DEQ 2010, 2011, 2012a, 2012b, 2013a; Formation 2012a, 2012b, 2013); correspondence between the Port and DEQ is presented in Appendix A and will hereafter be cited as "Port/DEQ correspondence, Appendix A." The additional scope includes incorporation of new data collected to support the Source Control Evaluation (SCE). The document was prepared on behalf of the Port of Portland (the Port) and Metro to satisfy (in part) requirements of the Voluntary Cleanup Program (VCP) Agreement (ECNWR-00-26) between the Port, Metro and the Oregon DEQ. The Facility is owned by Metro.

According to Oregon rules, an RERA is performed to supplement a Feasibility Study (FS) for a contaminated site to help identify the appropriate remedial action (OAR 340-122-0084(4)). The RERA estimates the residual risk associated with remedial alternatives and can be quantitative or qualitative (DEQ 2006b [FS guidance]). In the case of the Willamette Cove Upland Facility, DEQ approved the BERA, but requested fundamental changes to the risk assessment approach presented in the BERA, including (See Port/DEQ correspondence, Appendix A):

- Division of the site into four exposure units (EUs) (instead of one)
- Addition of two EUs along the shoreline of the Willamette River
- Addition of mammals to the detailed exposure and risk analysis
- Incorporating results of sampling conducted after the 2008 removal action (Central Parcel), results of beach samples from the Portland Harbor Superfund Site Remedial Investigation to be evaluated as part of the surface soil dataset, and the results of additional sampling and risk analysis for polychlorinated dibenzodioxins and dibenzofurans (PCDD/Fs)

- Changing exposure parameters for avian receptors

Based on these requests, the scope of the RERA is essentially equivalent to a full quantitative Baseline ERA, including re-screening of chemicals of interest (COIs) for each of the six exposure units. As a result, the structure of this RERA is based upon the process prescribed by DEQ in the *Guidance for Ecological Risk Assessment: Levels I, II, III, IV* (DEQ 2001).

The BERA (NF/ACA 2007) included a Level 1 ERA analysis for the site which indicated the presence of hazardous substances and potentially complete exposure pathways for ecological receptors. The BERA also included a Level II screening-level analysis, as well as an expanded analysis intended to address questions more related to DEQ's Level III analysis. The BERA was based on exposure estimated on Facility-wide basis, and concluded that risk at the Facility generally did not exceed Oregon acceptable risk levels (ARLs). However, DEQ subsequently requested risk analysis for the site be conducted separately for the three tax parcels (Port/DEQ correspondence, Appendix A). Subsequent requests added the Central Beach EU, the Inner Cove EU, and the Wharf Road EU (Port/DEQ correspondence, Appendix A). DEQ requested additional analysis that includes separate risk calculations for each of these units. The requested analysis is presented in this document.

Section 1 summarizes background information on the history and regulatory status of the site. The problem formulation and Level II Screening are presented in Section 2. The expanded exposure and risk calculation methods are described in Section 3, while the exposure analysis and risk characterization are presented in Section 4. Section 5 presents the overall conclusions and recommendations.

## 1.1 Facility Description

The Facility is located along the northeast bank of the Willamette River in the St. Johns section of Portland, Oregon between River Miles 6 and 7 (mostly in Section 12 of Township 1 North, Range 1 West, Willamette Meridian) (Figure 1-1). The DEQ Environmental Cleanup Site Information (ECSI) identification number for the Facility is 2066.

The Facility is bordered on the northeast by the Union Pacific Railroad (UPRR) right-of-way (Figure 1-2). Farther to the northeast is a vegetation-covered bluff that rises about 30 to 80 feet (ft) in elevation above the Facility. A residential area is present on top of the bluff and farther inland. On the southeast is an embankment for the Burlington Northern Santa Fe (BNSF) railroad bridge over the Willamette River. South of the BNSF embankment is the former McCormick & Baxter Creosoting Company, a federal Superfund Site. Adjacent to the northwest side of the Facility is a vacated portion of North Richmond Avenue. The Facility is bordered on the southwest by the Willamette River. The 'cove' adjacent to the eastern portion of the Facility (i.e., Willamette Cove) is a part of the river that is set back from the main river channel up to 800 ft. Figure 1-2 shows aerial photography from 2011 and identifies current features at the Facility, including the six exposure units.

## 1.2 Facility History

The Willamette Cove Upland Facility is currently owned by Metro. Metro acquired the property in 1996 for the purpose of creating a green space area to be used as a public park. Historically, Willamette Cove consisted of three separate "parcels" (West, Central, and East), each of which had different ownership and activities. Figure 1-2 shows the locations of the three parcels at the Facility. Details on the Facility history were previously provided in the Existing Data/Site History Report (Hart Crowser 2000) and in the Final Draft Remedial Investigation Addendum: Supplemental Preliminary Assessment of the Willamette Cove Upland Facility (Port 2003). Since the time of those reports, additional historical information about the Facility has been obtained. An updated summary of each parcel's history is provided below.

**West Parcel.** The West Parcel consists of approximately 5 acres (ac) and is the westernmost property of the Willamette Cove Upland Facility. The Port never owned or operated the West Parcel. Prior to 1901, the West Parcel was either undeveloped shoreline or used for residential purposes. An 1855 map shows the William Caples homestead was situated near the present-day intersection of North Richmond Avenue and the UPRR tracks. From about 1901 through 1963, the West Parcel was occupied by a plywood manufacturing plant. Historical maps indicate the early plant was relatively small, consisting only of a few buildings (a 1906 drawing shows three buildings and a dock) (Portland & Seattle Railway 1906). In February 1910, the plant burned to the ground, destroying the equipment and building. The plant was rebuilt and resumed plywood production in the fall of 1910. Available public records reflect that at full build-out, the plywood plant contained a glue mixing room, wood presses, an oil house, blacksmith shop, grinding room, and two debarkers. Many of these structures were built on piers or were directly adjacent to the waterfront. In addition, the central portion of the West Parcel and the adjacent river area were used as a log pond to store the logs used in the plywood mill.

The plywood manufacturing plant was operated by Portland Manufacturing Company (PMC) under various ownerships. PMC produced wood products including baskets, crates, wood drums, and excelsior (wood shavings for packing). In 1963, the plant was shut down and woodworking operations were discontinued. PMC and its affiliates or successors (culminating as Simpson Timber) owned the West Parcel until 1964, when it was sold to Portland Lumber Mills. Brand-S Corporation became owner via a merger with Portland Lumber Mills in 1966. After the plant shut down in 1963, a few buildings were used for sawmill operations. About 1972, all buildings on the West Parcel were demolished. By 1976, the former log pond on the parcel was filled. Since then, no development has occurred. The City of Portland, through the Portland Development Commission (City PDC), purchased the West Parcel from Brand-S in 1979. As previously mentioned, Metro acquired the West Parcel in 1996.

**Central Parcel.** The Central Parcel consists of approximately 11 ac and is situated in the center of the Facility between the West and East Parcels. Prior to 1900, most of the Central Parcel was submerged land. Maps of the area from the late 1800s show the bluff that is currently northeast of the Central Parcel extended directly to the river. As such, the Central Parcel upland did not exist historically (or if it did, it was riverbank along the present day UPRR tracks). In the 1920s, fill was placed between the dry docks (discussed below) and the UPRR tracks, creating the Central Parcel upland.

The Port acquired the Central Parcel in 1903. From 1903 through 1953, the St. Johns Dry Docks were located adjacent to the Central Parcel. The St. Johns Dry Docks was a “common user” plant, reputedly the only one of its kind in the United States, and was provided as a public service to support the commerce of the state. Oregon law forbade the Port to conduct repair activities and specified that “dry docks shall be kept open to all ship repairers and mechanics on equal terms”.

Initially, the dry dock complex consisted of a single dry dock with a 10,000-ton lifting capacity (Dry Dock 1). Dry Dock 1 was installed in 1904 and was situated approximately 200 ft from the riverbank. Two piers along the dry dock extended westward about 280 and 740 ft from the dry dock. Shore access to Dry Dock 1 was on a 22-foot-wide pier located in the eastern portion of the Central Parcel.

A second dry dock was constructed by the City Commission of Public Docks (City CPD) in 1921 and was positioned along the south side of Dry Dock 1. The new dry dock (Dry Dock 2) was larger than Dry Dock 1 and had a 15,000-ton lifting capacity. The City CPD was the initial owner of Dry Dock 2 and retained the maintenance responsibilities until ownership was transferred to the Port in 1923.

Between 1903 and 1918, other than the access pier, there were no buildings on the Central Parcel. Between 1907 and 1908, a small building with space allocated for an air compressor was constructed on the dry dock to be used as a blacksmith shop. Between 1915 and 1916, a new roadway to the dry dock was completed. A Power House with a 15,000-gallon steel aboveground storage tank (AST) for oil was built in 1904 and located directly north of the Central Parcel (i.e., offsite) (Oregonian 1904). The Power House was dismantled and use of the oil tank discontinued by September 1939.

In 1918, an overwater coaling dock with a rail spur was constructed about 100 ft from the riverbank. The coal dock was provided as a public service by the Port for use by private companies and the United States. The Port charged a tariff to allow private companies and the United States to handle and store coal at the wharf (Oregonian 1919). By 1924, use of the wharf for coal was discontinued and it was being used primarily for storage of machinery. Removal of the coaling wharf was initiated in 1934, and completed by December 1935.

Between 1918 and 1924, the Central Parcel was further developed with storage buildings; blacksmith, pipe, woodworking, and machine shops; a restaurant; an automobile garage; and a pattern loft. In 1921-22, an Auxiliary Plant was constructed at the dry docks for the ship repair contractors. Between 1924 and 1932, the 740-ft pier structure closest to the river bank was reconstructed with a new shorter dock (~400 ft long) and was straightened to be parallel to the other docks. The 1932 Sanborn map shows a warehouse and an additional blacksmith shop were constructed at the east end of the Central Parcel. Around 1939, the northwestern portion of the Central Parcel was used for storage. Between 1939 and 1948, the lawn at the southeast end of the Central Parcel was converted to an unpaved parking area. By 1953, operation of the St. Johns Dry Docks ceased and the dry docks were relocated to Swan Island.

In 1950, two of the three Central Parcel tax lots (99 and 124) were acquired by PMC, the owner of the adjacent West Parcel (prior to 1950, PMC had used the northeast portion of these tax lots). In

May 1953, Harold Scritsmier acquired tax lot 39 and purchased the in-river dock structures from the Port. Scritsmier constructed a sawmill at the north access pier. The Scritsmier plant consisted of a sawmill, filing room, shaving hopper, shaving bin, wharf with a rail spur, and green chain. Many of the structures formerly constructed in support of the dry docks were used in sawmill activities. By 1957, a few of the buildings were demolished, including the warehouse in the northwestern portion of the Central Parcel. In 1962, the large shop building was partially demolished, and then was damaged by fire. By 1965, the sawmill operations were significantly reduced and Scritsmier began leasing portions of the Central Parcel to private tenants. By 1970, the sawmill was no longer in use. The City PDC acquired the Central Parcel in 1981 and demolished the existing structures in the early 1980s. The Central Parcel has been vacant since that time. As previously mentioned, Metro acquired the Central Parcel in 1996.

**East Parcel.** The East Parcel consists of approximately 16 ac and occupies the southeastern most portion of the Willamette Cove Upland Facility. The Port never owned or operated the East Parcel. The East Parcel was originally lowland and wetland areas when it was acquired in 1900 by Western Timber Company. Western Cooperage, Inc. purchased the East Parcel in 1907 for the development of a general cooperage plant for manufacturing staves, barrels, kegs, lumber, shingles, and other timber products. In developing the East Parcel, Western Cooperage had the low-lying land filled up to 30 ft with dredged material. Construction was complete and the cooperage plant was in operation by 1915. The plant features included a grinding room, oil house, transformer house, battery charging room, glue mixing/gluing/press room, machine shop, overwater log lift debarker, and saw filing room; logs used in the cooperage were stored in Willamette Cove.

Western Cooperage manufactured barrels until the 1950s, when declining demand led to a focus on plywood production. By the end of the 1950s, log and timber supplies were no longer economical to transport to the area for processing. Aerial photographs indicate that the sawdust loading dock and connecting railway were demolished by 1957. In addition, aerial photographs and the 1963 city directory indicate that the mill was no longer operating. The East Parcel was sold to Western Associates in 1957. During the 1960s and 1970s, the large warehouse on the parcel continued to be used by other small businesses, including Flakewood, Inc., who continued to manufacture plywood at the property until 1967. In October 1967, a large fire destroyed much of the plant (Oregonian 1967). Most of the cooperage buildings were demolished between 1968 and 1971. Large log rafts were observed moored in the Cove after cooperage operations ceased through the 1970s, possibly storing logs for the McCormick & Baxter Creosoting Company.

The East Parcel was sold to West Coast Orient Company in 1975. The City PDC acquired the East Parcel in 1980. The City PDC removed the large warehouse by June 1981. As previously mentioned, Metro acquired the East Parcel in 1996. In 2004, DEQ removed wooden and concrete dock pilings and a derelict barge from the near shore area in response to mitigation requirements for the McCormick & Baxter Superfund Site cleanup.

## 1.3 Regulatory Status

Investigation activities are being conducted at the Facility under a VCP Agreement (ECNWR-00-26) for Remedial Investigation and Source Control Measures, effective November 4, 2000. This agreement is between the Port, Metro, and DEQ.

The scope of the risk assessments is limited to the upland portion of the Facility. The Facility is defined by the property boundaries and Mean High Water Mark (MHWM) (13.3 ft above mean sea level [amsl] North American Vertical Datum of 1988 [NAVD88]), as described in the VCP Agreement.

## 1.4 Summary of Investigations

Several environmental investigations have been performed at and near the Facility, including the adjacent shoreline and river sediments. A detailed discussion of these investigations and their findings are presented in the Existing Data/Site History report (Hart Crowser 2000) and the Remedial Investigation (RI) report (Hart Crowser 2003). A brief summary of these reports and subsequent investigations is provided below.

Prior to 2001, two environmental investigations (Sweet Edwards/EMCON, Inc. 1989, 1996) and an underground storage tank (UST) removal (Hahn and Associates 1999) were performed at the Facility. Samples were also collected from the Willamette Cove Upland Facility as part of studies of the adjacent McCormick & Baxter Superfund Facility (PTI Environmental Services 1992; Ecology and Environment 2000). The results of these investigations were analyzed as part of Phase I activities and are discussed in the RI report (Hart Crowser 2003).

From April 2001 through September 2002, Hart Crowser performed Phase II RI activities at the Facility to characterize the nature and extent of chemical contamination in soil and groundwater. The RI activities included completing 26 test pits, 30 push probes, and seven hand-augered soil borings; collecting 35 surface soil samples; installing seven groundwater monitoring wells; and performing two groundwater monitoring events. In addition, the extent of debris on cove beaches was mapped and the upland area and riverbank were inspected for erosion. In a letter dated December 20, 2003, DEQ provided comments on the RI report to the Port. Several of DEQ's comments expressed concern about potentially erodible soil on the riverbank at the Facility. DEQ also requested additional groundwater sampling.

In response to DEQ's comments, two additional groundwater sampling events were performed at the Facility in September and December 2005. The results are documented in the Groundwater Monitoring Report – Third Quarter 2005, (Blasland, Bouck, and Lee, Inc./Ash Creek Associates/NewFields [BBL/ACA/NF] 2005a) and Groundwater Monitoring Report – December 2005 (BBL/ACA/NF 2006a).

In addition, riverbank sampling was performed in December 2005 to address DEQ's comments regarding the potentially erodible soil on the riverbank of the Facility. Sampling was performed as outlined in the Riverbank Soil Sampling Work Plan (BBL/ACA/NF 2005b). The samples were analyzed for polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals and the results were presented in the Riverbank Soil Sampling Report (BBL/ACA/NF 2006b). PCBs were detected in one area of potentially erodible soil on the western portion of the East Parcel; however, the extent was not defined. A follow-up field investigation was performed in 2007 to define the extent of PCBs in areas of potentially erodible soil at this location. The results are provided in the Riverbank Soil Sampling Addendum (ACA 2008a).

Additionally, in a letter dated October 18, 2006, DEQ requested that the southern property boundary be surveyed to more accurately define the boundary between a BNSF railroad right-of-way and the Facility. The results of the survey are provided in the Riverbank Soil Sampling Addendum (ACA 2008a).

In 2007, soil sampling was performed to support removal action activities that were recommended in the Baseline Risk Assessment (ACA/NF 2007). The removal action was conducted to excavate surface soil that contained elevated metals and mitigate potential ecological risk. The work was completed in 2008 and the results are presented in the Removal Action report (ACA 2008b).

Additional sampling of the riverbank and beach soil was conducted in 2010. In addition, four exploratory trenches on the beach portion of the East Parcel were excavated and grab samples of soil and groundwater were obtained and analyzed for petroleum hydrocarbons and PCBs. The results are presented in the Source Control Sampling Results letter report (ACA 2011).

Lastly, PCDD/Fs were recently identified in one area of non-erodible soil near the former road leading onto the wharf (ACA 2011). Additional surface soil sampling at the Former Wharf Road Area was conducted in August 2012 in accordance with DEQ's approved work plan, *Revision to Proposed Surface Soil Sampling- Former Wharf Road Area* (dated June 25, 2012), as cited in ACA 2012. Surface samples were collected from three decision unit areas using an incremental soil sampling technique. Soil samples were analyzed for extent of PCDD/Fs (ACA 2012).

The sampling events outlined above provide a comprehensive dataset that adequately characterizes the soil and groundwater conditions at the Facility. COIs and potential areas of concern (AOCs) were identified from the historical use review (Hart Crowser 2000) and previous investigations as summarized above. Results of the RI indicated the presence of some COIs in soil and groundwater. The BRA (NF/ACA 2007), and RHHRA (FE/Apex, submitted December 2013) evaluated the potential risks to human health from COIs in Facility soil and groundwater to potential human receptors. As indicated in the introduction, the RERA presented in this document further evaluates the potential risks posed by the presence of these COIs in Facility surface soil to potential ecological receptors.

This RERA uses these data for risk evaluations because this dataset is relevant, current, and of known data quality suitable for risk assessment purposes.

## 1.5 Facility Land and/or Water Uses

### 1.5.1 Current Uses

The Facility is currently vacant, covered with invasive and native vegetation, and provides habitat for opportunistic use by wildlife. The Facility is not managed for any human use and is posted to prohibit trespassing. However, trespassers do come on site (e.g., homeless persons and joggers).

The Facility is currently zoned as an Open Space (OS) zone with “g” (River General) and “q” (River Water Quality) greenway overlay zones (City of Portland 2004). The OS zone is intended to preserve and enhance public and private open, natural, and improved park and recreational areas. Greenway regulations are also intended to protect, conserve, enhance, and maintain the natural, scenic, historical, economic, and recreational qualities of lands along Portland’s rivers. Specifically, the “g” overlay is intended to allow public use and enjoyment of the waterfront and for enhancement of the river’s scenic and natural qualities. The “q” overlay is designed to protect the functional values of water quality resources by limiting or mitigating the impact of development in the 25-foot setback from the top of bank. Other nearby zoning includes commercial (EG2), residential (R2 and R5), open space (OS), and industrial (IH and IG2) (City of Portland 2004).

The Facility was included in a citywide inventory which identified three scenic resources at or near the Facility (City of Portland 2000). First, the entire Willamette River through Portland was designated as a scenic corridor, offering outstanding views of the West Hills, bridges, and riverfront natural areas. Second, a scenic viewpoint was identified on the Facility, looking northward to the St. Johns Bridge. Viewpoints provide locations where the public can enjoy the natural and built environment. Third, Willamette Boulevard, on the bluff northeast of Willamette Cove, was also designated as a scenic corridor, with views of the river, the city, and the West Hills.

### 1.5.2 Future Uses

Portland Parks and Recreation has prepared a draft management plan for the Willamette Cove Upland Facility (City of Portland 1999). This report indicates that one potential plan for the Facility would be an urban natural area with passive recreation opportunities (i.e., a park). The plan includes a “Cottonwood Forest” zone in the East Parcel which would have clusters of large trees, a natural-resources education area for children, a rustic picnic area, bird watching opportunities, and a parking lot for up to 40 vehicles. The Portland Bureau of Parks and Recreation has also identified the need for a park in this area, listing both Willamette Cove and the McCormick & Baxter Superfund Facility as potential locations (after cleanup) for natural areas, river access, and recreation (City of Portland 2001).

The Facility is included in a citywide inventory that identified scenic resources at the Facility (City of Portland 2012). The Facility is identified as a scenic viewpoint. The zoning map shows a recreational trail through the Facility (City of Portland 2004). However, this trail is only proposed as part of the regional trail plan adopted by Metro (Alta Planning and Design 2010).

Therefore, the reasonably likely future use of the Facility is for recreation. The actual site plan and type of recreational use or development is not known at this time. Until redevelopment for recreational purposes is initiated, current land use of the Facility is not anticipated to change.

## 1.6 Facility Cleanup Actions

Three cleanup actions have been performed at the Facility, including one in 1999 on the West Parcel, a second in 2004 on the East Parcel, and a third in 2008 on the Central Parcel. Details on the July 1999 cleanup action can be found in a report prepared by Hahn and Associates (1999); details on the 2004 removal action are contained in a memorandum prepared by ACA/Hart Crowser (2005); and details on the 2008 removal action are contained in a removal action report prepared by ACA/NF (2008b). The following summarizes the results of the actions:

- Several gallons of black tarry oil were observed on the ground surface of the West Parcel during brush clearing activities in July 1999. The oil and associated petroleum-contaminated soil (about 127 tons) were removed and transported off the property for treatment. During the removal, a 12,000-gallon UST was discovered at a depth of 7 ft. The UST was subsequently removed from the West Parcel (Hahn and Associates 1999). The excavation was backfilled by grading soil from the surrounding area into the excavation.
- On July 6, 2004, product sheen was observed at Willamette Cove during implementation of the remedial action at the McCormick & Baxter Creosoting Company Superfund

Facility (McCormick & Baxter Facility). Test pits in soil directly above the ordinary line of low water (OLLW) indicated the presence of petroleum product. A removal action was performed in accordance with the October 5, 2004, Scope of Work (SOW) prepared by the Port and Metro and approved by DEQ. The removal action defined the extent of the petroleum product and removed the mobile petroleum product from Metro's property to the extent practicable through soil excavation.

- A removal action consisting of excavation and off-site disposal of metals-impacted soil was completed in June 2008. The purpose of this removal action was to remove soils with lead and other metals to decrease residual risks to ecological receptors. A limited area on the eastern portion of the Central Parcel contained elevated concentrations of lead and other metals in surface soils. Although the baseline risk assessment (NF/ACA 2007) did not identify unacceptable risk associated with the metals from an overall site perspective, a removal action to excavate and dispose of these soils off-site was performed to reduce the likelihood of localized adverse effects to plants, birds, or mammals in the eastern Central Parcel. A total of approximately 987 tons of soils containing lead and other metals were removed from the Facility and disposed at the Waste Management's Hillsboro landfill. This included 356 tons of soil that was stabilized prior to disposal to remove the hazardous characteristic and 631 tons of soil that did not require stabilization before disposal. Relative concentration reductions for arsenic, chromium, copper, and lead were calculated to provide a semi-quantitative measure of the removal effectiveness. Concentrations of these metals were reduced between 56% and 99.5% as a result of the action (ACA 2008c).

# 2.0 ECOLOGICAL SITE DESCRIPTION, CSM, LEVEL II SCREENING

The ERA process for the Willamette Cove Upland Facility is based upon the process prescribed by DEQ in the *Guidance for Ecological Risk Assessment: Levels I, II, III, IV* (DEQ 2001). The guidance describes a sequence for conducting ERAs, beginning with Level I Scoping. The purpose of the Level I Scoping ERA is to provide a qualitative determination of whether there is reason to believe that ecological receptors and/or exposure pathways are present at the Facility (DEQ 2001). The Level I analysis includes the Facility description as it relates to potentially contaminated environmental media, and the potential exposure to ecological receptors. The conclusion of the Level I analysis presented in the BERA (NF/ACA 2007) was that hazardous substances are potentially present, and ecological conditions at the site were such that receptors could be exposed. The Level I analysis is not repeated here, but the information site description provided with the Level I and II analysis in the BERA are presented to provide context for the exposure and risk analysis.

## 2.1 Ecological Facility Description

An overall description of the location, physical features, current uses, and history of the Facility is presented in the RI report (Hart Crowser 2003). The following sections are intended to supplement that information for elements relevant to the Level I Scoping and Level II Screening.

The Portland area has a temperate marine climate characterized by mild, wet winters and moderately warm, dry summers. According to Oregon State University's Oregon Weather and Climate Data Website (2003), precipitation averages 36 inches per year, with approximately 75% of the precipitation occurring between October 1 and March 31. Monthly average temperatures range from a low of approximately 34°F in January to a high of approximately 80°F in July and August.

The VCP describes the Facility as being comprised of 27 ac of land surface, although this estimate may be slightly high. The shoreline with the Willamette River is approximately 3,900 linear ft, based on interpretation of an aerial photo from May 2002. The land surface and shorelines may vary somewhat as water levels in the river change. According to the City of Portland (2000), the existing vegetation communities at the Facility include bottomland forest (approximately [~] 11 ac), upland shrub (~13 ac), dry meadow (~1 ac), and wet meadow (~1.5 ac) (Figure 2-1). The remainder is riverbank/beach area. However, a significant portion of the East and Central (eastern one-half) Parcels is ruderal, with large tracts of barren ground and weedy species.

The bottomland forest areas occur within a narrow corridor along the length of the Facility. These areas are dominated by young black cottonwood trees and non-native tree species, such as Lombardy poplar, catalpa, and holly (City of Portland 2000). Other species include Pacific willow, cherry, and birch. Many of the ornamental and non-native tree species were apparently planted on the former building grounds. The understory of the bottomland forest area is dominated by invasive species such as Himalayan blackberry, English ivy, clematis, and reed canarygrass which suppress plant diversity in the understory areas, especially along the river bank and in edge areas. The forest area is bisected in areas by well-worn and compacted dirt trails (City of Portland 2000).

The meadow area at the northwest end of the Facility (i.e., West Parcel) is fairly open and includes mesic and dry sections. Herbaceous vegetation in these areas is dominated by weedy grass and herb species, such as Queen Anne's lace, reed canarygrass, nightshade, crabgrass, horsetail, vetch species, and timothy grass (City of Portland 2000).

The scrub-shrub area in the Central and East Parcels is characterized by Scot's broom, Himalayan blackberry, Indian plum, native hawthorn, elderberry, and sumac (City of Portland 2000). The ruderal portions of the Central and East Parcels are open areas with weedy grass and herb species. The open areas show signs of disturbance including packed vehicle and foot trails, parking areas, and ruins from former industrial facilities. The open areas in the middle of the Central Parcel show signs of disturbance of two activities in 2005 and 2008. In 2005, the area was used for stockpiling materials and staging area for upland capping activities at the McCormick and Baxter Superfund Site. That area in the Central Parcel was graded with new fill (M&B upland cap material) and is being colonized by grasses and blackberry. In 2008, the Port conducted a voluntary removal action on a small area (987 tons from < 1 ac) to address elevated metals concentrations in soils (ACA/NF 2008b). That area partially overlaps with the area that was regraded after the McCormick and Baxter stockpiling.

Much of the riverbank along the West and Central parcels is high (20-30 ft. in some places) and steep. In some areas, the bank is heavily armored with rip-rap. There is a wooden seawall along the shoreline at the upstream end of the Central parcel. The shoreline of the East parcel is largely beach that extends around the most inset part of the cove. As part of the remedy at the McCormick and Baxter site, a sand cap with an armored surface was installed along much of southern shoreline of the cove. This armoring was covered with sand and gravels, but the armoring is visible in some areas (Figure 2-1).

No formal wildlife surveys have been conducted for the Facility. During Facility visits, various songbirds (including American robin, brewer's blackbirds, and song sparrows) and red-tailed hawks have been observed. No mammalian wildlife, or signs thereof, were observed during Facility visits, but it is likely that small rodents such as mice and voles are resident, and urban-adapted species such as raccoons and fox squirrels probably frequent the Facility. As a relatively isolated, 27 ac parcel, the Facility is too small to harbor resident deer, fox, or coyote. However, such species may visit the Facility during movements through vegetated corridors in the area.

The Willamette River is adjacent to the Facility, but no permanent surface water bodies are present on the Facility. Along this reach, the river flows to the northwest and is about 1,300 ft wide. Willamette Cove is an embayment of the Willamette River and is set in up to 800 ft from the main river channel.

### 2.1.1 Sensitive Environments and Threatened and/or Endangered Species

Based on specific environments listed in OAR340-122-115 (50), and the Oregon Natural Heritage Information Center (ORNHIC) information on protected species, there are no sensitive environments at the Facility. The Facility is adjacent to the Willamette River, which is a sensitive habitat according to Oregon regulations because it harbors protected fish and wildlife species. A list of threatened and endangered (T/E) species potentially present in the area was provided by ORNHIC in 2007. At the time, bald eagle and peregrine falcon were identified as potentially present, but none had been observed. Both species have since been de-listed. No other listed species have been identified and the Facility does not contain critical habitat features for currently listed terrestrial species. The Willamette River contains habitat for several fish species of interest, including green sturgeon, chinook salmon, coho salmon, and steelhead. The Facility does not provide aquatic habitat in which these fish species would be found, but there are potential pathways for transport of COIs to the river. Exposure and risks of receptors in the Willamette River is outside the scope of this RERA (Refer to Section 2.3, Conceptual Site Model and Exposure Pathways).

## 2.2 Observed Impacts

***Impacts on Biota:*** No impacts on ecological receptors were observed at the Facility. No signs of toxic stress from COIs were observed during Facility visits. Such signs could include stressed or dead vegetation, patches of barren soil, or dead or dying animals that could not be explained based on other factors. Barren soil areas were observed in the East and Central parcels, but much of this area is hard-packed gravel surfaces that have experienced heavy vehicle traffic or are the former locations of buildings. In the Central and West Parcels, foot trails used by transients and joggers/hikers are largely devoid of vegetation in the most heavily used areas. Adjacent areas support grasses, herbaceous species, and shrubs, suggesting that stress to vegetation in barren areas is from physical factors.

***Organic Chemical Sheens:*** Sheens have been observed on surface water along the shoreline of the site. The observations of sheen on soil samples from the West and Central Parcels were noted as part of the field screening procedure. The sheens could be interpreted as the presence of separate-phase petroleum (or other organic liquids) in soils or shallow subsurface water at the site. If so, such sheens could indicate areas of highly concentrated risk. The nature of the sheens from water at Willamette Cove was not tested. However, sheen testing on soil can only provide a relative indication of whether heavier hydrocarbons are present, not necessarily indicate that free product is present. (Note that sheens can be produced from both petroleum products and natural processes).

As indicated in Section 1.6, petroleum sheen was observed at the Inner Cove Beach area during DEQ implementation of the remedial action at the McCormick & Baxter site in 2004. However, subsequent test pit excavation and removal action conducted by the Port demonstrated that there was no continuing source to the river from the upland area; and appeared to be a localized source area. The excavation was terminated at the edge of the water, so residual product may have remained beneath the Oregon Division of State Lands (DSL) property located riverward of the OLLW.

***Slag Observations:***

The RI report (Hart Crowser 2003) described the presence of slag material on the northeastern area of the beach in the Inner Cove beach area. This area is not within the Facility as it is below the MHWM. The slag was described as a glassy material with soil or sand embedded. The source of the slag is unknown. Chemical analysis of the slag showed concentrations of copper and nickel elevated with respect to background, and chromium, copper, and nickel exceeding screening levels adopted for the RI. The RI noted that although concentrations were elevated, it is unlikely the metals in the slag represent significantly increased exposure and risk because of the solidified nature of the material and the restricted distribution. In addition the majority of this area was overlain by the armored sediment cap installed as part of the McCormick & Baxter site. In 2010, the Port and Metro collected a composite sample (WC-SSX) of a slag-like material on the Central Parcel beach for analysis for PAHs and PCBs at the request of DEQ. This area is not within the Facility as it is below the MHWM. The laboratory analytical results indicated that PAHs and PCBs were not detected above the method reporting limits (MRLs; ACA 2011).

## 2.3 Conceptual Site Model (CSM) and Exposure Pathways — Ecological

A conceptual site model (CSM) provides information about contaminant sources, release mechanisms, potential receptors, and exposure pathways at a site. Preliminary identification of potential exposure pathways for ecological receptors was outlined in a Preliminary CSM in the RI report (Hart Crowser 2003), and an updated CSM is presented as Figure 2-2. The CSM figure was modified from that shown in the RI report based on discussions with DEQ personnel in an April 12, 2005 meeting, comments submitted by DEQ on October 16, 2006 and subsequent Port/DEQ correspondence, Appendix A.

Modifications include identification of pathway/receptor categories that are being addressed through the Portland Harbor RI/FS risk assessment process. DEQ specified that the Willamette Cove Upland risk assessment should not include the exposure pathways being evaluated in the Portland Harbor RI/FS. As a result, this risk assessment will not address risk to ecological receptors from direct contact with contaminants in beach sediments, surface water or sediment in the Willamette River; or bioaccumulation of COIs from surface water or sediments.

DEQ also requested that the Upland Facility Risk Assessment not include pathways addressed in the formal Source Control Evaluation that the Port is preparing for this Facility. Therefore, this RERA does not address pathways potentially resulting from transport of Facility groundwater to surface water in the Willamette River, or transport of erodible riverbank soils to the river.

[Note that the RI report had identified the transport of COIs to the river via erodible riverbank soils as an incomplete pathway. Based on requests from DEQ in its December 20, 2003 letter to the Port, and subsequent investigation, a few erodible riverbank areas at the Facility have since been identified and this pathway is considered potentially complete in these limited areas. The possible effect of erodible soils on sediment and surface water quality in the Willamette River are characterized and evaluated separately as a part of a Source Control Evaluation and is not described further in this document.]

A general evaluation of potential ecological exposure pathways is provided in the Level I Scoping checklists in the BERA (BERA, Appendices A-1 and A-2). The primary contaminant sources and release mechanisms are release of chemicals to soil or impervious surfaces as a result of onsite or offsite operations.

The potentially complete ecological exposure pathways outlined in the CSM (and discussed in Hart Crowser 2003) that are a part of this risk assessment include the following:

Direct Exposure Pathways:

- direct contact with contaminated surface or subsurface soil through contact with external surfaces or ingestion (terrestrial receptors).

Indirect Exposure Pathways:

- ingestion of terrestrial food sources that have become contaminated through direct or indirect pathways (i.e., food web exposure).

**Direct Contact with Contaminated Soils**. Receptors may encounter contaminated soils at or near the ground surface. Direct contact includes potential ingestion or inhalation of dusts generated by wind or ground disturbance (e.g., traffic). Ecological receptors, such as invertebrates and burrowing small mammals, can be exposed by burrowing into contaminated soils.

**Indirect Exposure to Contaminated Soil**. Contaminants can be taken up by plants and invertebrates, and ingested by organisms in higher trophic levels.

**Groundwater Exposures**. Since shallow groundwater is approximately 25 and 30 ft below ground surface (bgs), no terrestrial receptors at the Facility are exposed to groundwater.

## 2.4 Exposure Units

The BERA treated the site as one exposure unit, and exposure point concentrations for the Level II screening were based on aggregation of data across the entire Facility. The BERA exposure and risk analysis were focused on the Central Parcel only, because the greatest potential for risk was from metal concentrations in soils in that parcel.

As a result of their re-evaluation of the BERA and defining scope for the RERA, DEQ requested that the site be divided into six EUs (Figure1-2):

1. West Parcel Upland EU (4.85 ac)
2. Central Parcel Upland EU (9.9 ac)
3. East Parcel Upland EU (7.4 ac)
4. Inner Cove Beach EU (1.4 ac)
5. Central Beach EU (0.4 ac)
6. Wharf Road EU (0.34 ac)

The West Parcel, Central Parcel, and East Parcel Upland EUs are based on the tax lots in the upland areas of the Facility, bounded by the MHWM on the riverward side of the parcels. The Inner Cove Beach EU is adjacent to the Central Parcel and East Parcel Upland EUs, and consists of the area between the MHWM and the OLLW in the interior cove area, and includes primarily the beaches and shoreline. The Central Beach EU is adjacent to the Central Parcel EU (upland), between the MHWM and OLLW. The Inner Cove Beach EU and the Central Beach EU are not within the Facility Boundary as defined in the VCP, but are included in this RERA based on comments from DEQ (Port/DEQ correspondence, Appendix A).

The Wharf Road EU is defined by the three multi-incremental sampling decision units (DUs) developed for assessing the potential concentrations of PCDD/Fs in soils in the area formerly occupied by the access road from the upland area to the St. Johns dry docks. The area is small (~0.34 ac) and likely does not constitute an area large enough to support small birds or mammals. However, risk calculations were performed using the PCDD/F data from the DU samples.

Figures 2-3 through 2-7 show the surface soil sampling locations in each of the EUs. Data from these locations were used in the Level II screening described in the remainder of Section 2, and the expanded exposure and risk calculations in Section 3.

The BERA for the Portland Harbor Superfund Site (PH-BERA) (Windward 2011) evaluated risk for wading birds based on composite beach samples from the Inner Cove Beach EU and Central Beach EU. Results of the PH-BERA are included in the Risk Characterization discussion for these two EUs in Section 4.2.

## 2.5 Level II - Screening

### 2.5.1 Methods for Level II Screening

The ecotoxicological risk screen was conducted according to DEQ guidance for Level II Screening (DEQ 2001). DEQ guidance specifies several tasks when the Level II analysis is conducted independently. However, many of the tasks and much of the background information cited in the Level II guidance were addressed in the Level I evaluation (i.e., conduct site survey, provide site description, identify ecological receptors, and identify complete exposure pathways). Therefore, the analysis presented below focuses on the tasks that relate directly to conducting the Level II screen, including:

- evaluate data sufficiency (Task 1 of the guidance);
- identify candidate assessment endpoints (Task 6);
- identify known ecological effects (Task 7);
- calculate COI concentrations (Task 8); and
- identify contaminants of potential ecological concern (CPECs) (Task 9).

### 2.5.2 Data Available for Screening

Analytical results from the RI sampling (Hart Crowser 2003) and subsequent sampling events (e.g., BBL/ACA/NF 2005a, 2006a, 2006b; ACA/NF 2008b, 2008c; ACA 2010a, 2010b, 2011, 2012) provide a comprehensive dataset that adequately characterizes the current soil conditions at the Facility, and are sufficient to perform the screen for all portions of the Facility. Sampling locations are shown in Figures 2-3 through 2-7; all soil analytical results used in the ecological risk evaluations are listed in Appendix B.

In accordance with DEQ policy, data from soil samples to 3 ft bgs were included in the ecological risk screening analyses, to adequately account for surface exposure and potential exposure to burrowing animals. Analytical data for soil samples from less than 4 ft bgs[1] are available for sampling locations in each of the EUs (Figure 2-3 through 2-7). Soil samples were analyzed for COIs including a range of organic compounds and metals, as summarized in the RI report[2] and subsequent data summary reports.

### 2.5.3 Screening-Level Assessment Endpoints

According to DEQ guidance (2001), assessment endpoints are "…an explicit expression of a value deemed important to protect, operationally defined by an entity (hereafter, "endpoint receptor") and one or more of that entity's measurable attributes…" Assessment endpoints serve to focus the ERA on species and measures that are directly relevant to risk management decisions for a site. The assessment endpoints generally represent species or functional groups that are important to ecological function at a site, or rare species that have great ecological, aesthetic, or cultural value.

Assessment endpoints for a screening level assessment (e.g., Level II screening) are typically not as specific as those identified for baseline risk assessments where specific measures or data analysis methods are needed to make decisions. In addition, no T/E or other rare species are known to occur at the Facility. For the DEQ Level II analysis, SLVs for soils and surface water have been identified for general groups of organisms including plants, invertebrates, birds, mammals, and aquatic receptors. Based on DEQ guidance (DEQ 2001), the following screening-level assessment endpoints were identified for the RERA:

- Survival and reproduction of terrestrial plants;

[1] The depth and length of intervals in available soil samples vary widely. To ensure that data representative of the 0-3 ft bgs were included, soil samples with an upper depth of less than 3 ft bgs and a bottom depth of less than 4 ft bgs were included in the evaluation.

[2] Nine results for benzo(b+k)fluoranthene from samples collected between 1991 and 2001 were excluded from the risk analysis because there were additional results for the individual isomers that were more conservative. Results for PAHs using method 8270-SIM were used preferentially over results obtained using method 8270 and results for phenols using method 8041 were used preferentially over results obtained using method 8270A.

- Survival and reproduction of terrestrial invertebrates;
- Survival and reproduction of terrestrial-feeding birds;
- Survival and reproduction of carnivorous birds; and
- Survival and reproduction of terrestrial-feeding mammals.

### 2.5.4 Calculating COI Concentrations

Because wildlife receptors do not experience their environment on a "point" basis, environmental data for each COI need to be converted to an estimate of concentration over a habitat exposure area (DEQ 2001). Exposure-point concentrations (EPCs) are concentrations of COIs that represent a reasonable maximum exposure based on the media characteristics and site-specific receptors. The Level II guidance specifies that screening-level EPCs can be based on (1) site maximum detected concentrations (MDCs) for immobile or nearly immobile receptors (i.e., plants, soil invertebrates), or (2) 90%-upper confidence limits (90UCL) of the mean concentrations for more mobile wildlife receptors (i.e., birds, mammals) (DEQ 2001).

Only soil data were used for the risk screening. Soil samples from less than 4 ft bgs were included in the calculations to adequately account for exposure to receptors at the ground surface, and to potential burrowing animals. MDCs for all COIs were screened against background and screening level values (see below) before calculation of 90UCLs. If the MDC for a COI was less than the background value, then the COI was excluded as a CPEC.

For determining an MDC, all samples with detected concentration results for both composite and discrete, were included in the determination. For determining an EPC based on 90UCL, separate calculations were used for discrete and composite sample results, based on recommendations in the ProUCL guidance (EPA 2010). The EPA ProUCL computer program (EPA 2011) was used to calculate the 90UCLs for COIs that exceeded Level II screening criteria based on MDC. At least five data points were necessary before the term was calculated; otherwise only the maximum value was used. The 90UCL was calculated regardless of detection frequency. The recommended methods provided by ProUCL, based on the distribution of each data set, were used to select the 90UCL values. The selected values and methods are listed in Section 2 tables, and ProUCL output is provided in Appendix C.

### 2.5.5 Frequency of Detection and Background Analysis

In accordance with DEQ guidance, COIs were screened based on comparison to regional background levels before being compared to toxicity SLVs, as outlined in Task 9 of the Level II guidance (DEQ 2001). The DEQ Level II guidance also includes screening out chemicals that are detected in less than 5% of samples. However, in its request for the RRA, DEQ requested that this criterion not be used for Willamette Cove (Port/DEQ correspondence, Appendix A). Regional background concentrations listed for the Portland Basin on Table 4 in DEQ (2013b) were used to assess background for naturally occurring metals. DEQ does not consider organic chemicals as naturally occurring, and does not consider background screening in the CPEC identification process. If the MDC for a COI was less than the background value, then the COI was excluded as a CPEC.

### 2.5.6 Screening Level Values (SLVs)

SLVs published by DEQ (2001) for use in Level II analyses were used in the screening-level analysis, with some SLVs replaced by US EPA Eco Soil Screening Levels (Eco SSLs) and other values requested by DEQ (See Table 2-1; Port/DEQ correspondence, Appendix A). These values are generally based on no-observed-adverse-effects-levels (NOAELs) for each of the COIs. Therefore, if site concentrations are less than the SLV, no adverse effects are expected and no further analysis is required because risk is assumed to be negligible. The SLVs are based on intensive use of a site by receptors. Concentrations that exceed the SLV do not necessarily represent unacceptable risk, but indicate that additional evaluation of site conditions may be necessary to support risk management decisions.

## 2.6 Screening Results and Identification of Contaminants of Potential Ecological Concern (CPECs)

CPEC identification was conducted according to Task 9 of the DEQ guidance (DEQ 2001), including consideration of cumulative risk from multiple COIs, bioaccumulative toxins, and screening level availability. CPECs were identified by calculating the toxicity ratio (T) of the EPC (MDC or 90UCL) of each of the COIs to Level II SLVs (DEQ 2001). The guidance indicates two potential levels of analysis for soil COIs. For T/E species, the toxicity ratio is compared to the “receptor designator” (Q) value of 1 (i.e., if the Facility soil concentration exceeds the SLV, the constituent is identified as a CPEC). For non-protected species, T is compared to a Q value of 5 (i.e., if the Facility soil concentration exceeds five times the SLV [5x-], the constituent is identified as a CPEC). For completeness, both levels of results are presented in this document. However, CPECs were identified for the Facility based on Q=5 because no T/E species are present at the Facility. In addition, potential risk to a receptor from multiple COIs simultaneously within a given medium was addressed by comparing T of an individual COI to the sum of T for all COIs.

### 2.6.1 Soil CPECs

#### 2.6.1.1 Frequency of Detection and Background Analysis

*Frequency of Detection:* DEQ guidance (2001) advises eliminating any constituent reported as detected in less than 5% of samples from further risk evaluation, but based on DEQ comments (Port/DEQ correspondence, Appendix A), this RERA does not incorporate frequency of detection into the screening evaluation.

*Background:* The MDCs of naturally-occurring COIs are compared to background values in DEQ guidance (Table 4 of DEQ 2013b), and shown in Table 2-1. Those chemicals whose MDC was less than the default background concentration were eliminated and not considered further in this RERA. This screening step applies to metals only and not to chemicals of anthropogenic origin (e.g., PAHs).

#### 2.6.1.2 Screening Analysis

***Identification of Candidate CPECs***

Appendix D shows the results of the soil toxicity screens for each receptor (plants, invertebrates [inverts], birds, mammals) for each of the EUs based on COIs for which the MDC exceeded at least one SLV with a risk ratio (Q) greater than 5. These constituents are considered candidate CPECs that are subject to further analysis including calculation of 90UCLs and comparison to appropriate SLVs for each of the receptor groups. Chemicals that were not detected, but for which the highest non-detected result (i.e., highest detection limit) exceeded the screening levels, were retained in the screening tables. In addition, these tables include CPECs that were identified as a result of potential risk to a receptor from multiple COIs (DEQ 2001).

### *Comparison of MDCs to SLVs for Non-Wildlife Receptors*

Appendix D summarizes results of the soil toxicity screens based on comparison of MDCs to SLVs. In addition, the tables also indicate which MDCs exceeded SLVs with a risk ratio greater than 1, and which MDCs exceeded SLVs with a risk ratio greater than 5 (i.e., the MDC was greater than 5x-SLV). A summary of CPECs exceeding SLVs are shown in Tables 2-2 through 2-7. Figures 2-8 to 2-17 show the locations at which CPEC concentrations exceed the plant or invert SLVs.

### *Comparison of 90UCLs to SLVs for Wildlife Receptors*

For bird and mammal receptors (i.e., wildlife receptors), EPCs based on 90UCLs were calculated for all CPECs identified based on comparison of MDC to background concentrations and SLVs. Refer to Appendix D for the results of screens based on comparisons of the calculated 90UCLs to SLVs. Tables 2-2 through 2-7 summarize the results of the soil toxicity screens for each of the EUs based on comparison of 90UCLs to SLVs. The summary table indicates which 90UCLs exceeded SLVs with a risk ratio greater than 1, and which 90UCLs exceeded SLVs with a risk ratio greater than 5 (i.e., the 90UCL was greater than 5x-SLV). As noted above, a risk ratio of 5 corresponding to non-T/E species was used for identifying CPECs.

DEQ directed that all chemicals for which SLVs were not available were to be identified as CPECs and considered in the risk conclusions and uncertainty assessment (Port/DEQ correspondence, Appendix A). The COIs for which SLVs were not available for at least one receptor are shown in Table 2-8.

## 2.7 Technical-Management Decision Points (TMDPs) and Recommendations

Level II technical-management decision points (TMDPs) are steps in the risk assessment process where one of three recommendations is determined: 1) no further ecological investigations needed at a site; 2) continuation of the risk assessment process to the next level; or 3) undertake a removal or remedial action (DEQ 2001). The information gathered during the Level I Scoping and Level II Screening processes are used to evaluate TMDP 3 and TMDP 4.

### 2.7.1 TMDP 3

According to DEQ guidance (2001), the potential for risk exists when CPECs are present and there are complete exposure pathways between contaminated media and ecological receptors. The Level I scoping indicated that the potential for exposure exists at the Facility based on the presence of contaminated media and possible contact with receptors, resulting in the need for a Level II screening analysis. The guidance indicates that unacceptable risk is possible only if results of the Level II analysis indicated that the Facility: 1) contains any individuals of a T/E species, critical habitat of a T/E species, or contains habitat of sufficient size and quality to support a local population of non-T/E species; 2) CPECs were selected on the basis of exceedance of SLVs or because they have a high potential to bioaccumulate; and 3) there appears to be plausible links between CPEC sources and endpoint receptors (DEQ 2001).

The Level I and Level II analysis show that the Facility is an urban natural area capable of supporting local populations of non-T/E species. As discussed in the previous section, the concentrations of multiple CPECs (metals and organic chemicals) exceeded DEQ SLVs, and plausible links exist between CPEC sources and endpoint receptors. For example, vegetation developing on contaminated upland soil potentially provides a dietary source for contaminants to enter food web pathways at the Facility. However, without further risk analysis, it is unclear whether these concentrations represent unacceptable risk under Oregon rules. Additional risk analysis, would help determine whether risks are unacceptable, and/or to develop risk-based cleanup goals for the Facility.

### 2.7.2 TMDP 4

DEQ TMDP 4 refers to whether risk managers are willing to make response action decisions on the basis of the Level I and Level II Screening analysis alone, or whether additional risk analysis is necessary. DEQ indicated that the existing risk analysis in the BRA, which included Level I, Level II, and Level III-type analyses were inadequate to make risk management decisions, and requested additional ERA analysis for the Facility. In discussions regarding the scope of the RERA, DEQ and the Port agreed to additional analysis including expanded Level II analysis and preliminary Level III probabilistic analysis.

# 3.0 EXPANDED EXPOSURE AND RISK CALCUATION METHODS

## 3.1 Purpose and Scope

Results of the ERA Level I Scoping and Level II Screening identified some chemicals, primarily metals, PAHs, PCDD/Fs, and PCBs that exceeded screening values established by DEQ. The Level II screening evaluation identified CPECs for plants, invertebrates, birds and mammals for each EU (Tables 2-2 through 2-7). The Level II SLVs are intended as screening-level estimates of soil concentrations below which no adverse impacts are expected to ecological receptors under any exposure conditions. However, they are not meant as cleanup values and exceedance of the SLVs does not necessarily indicate unacceptable ecotoxicological risk, nor should they be used as cleanup criteria (DEQ 2001). EPA's EcoSSLs were developed in a similar context (EPA 2007).

An expanded Level II ecological risk analysis was conducted to provide more information on potential ecological exposures and risk at the Facility. The expanded analysis includes expanded exposure and risk calculations for representative species of small bird and mammals that may spend all, or most of their life-cycle at the facility. In addition, exposure to bioaccumulative chemicals was assessed for higher-trophic level carnivorous bird and mammal species. The expanded analysis is intended to augment the Level II screening-level comparisons to SLVs. For some CPECs, the analysis also includes preliminary Level III analysis using probabilistic methods to compare risks to Oregon ARLs. This analysis is not necessarily equivalent to a Level III analysis because no data on CPEC concentrations in potential forage or prey species have been collected for the site to provide data on uptake of CPECs from soil into the local food chain.

Expanded Level II assessments for birds and mammals are presented in the following sub-sections. Exposure and risk calculations were conducted to estimate exposure of resident songbirds and small mammals that would be resident at the site, and spend all or most of their time there. The American robin (*Turdus migratorius*) was identified as the representative species for songbirds; the representative small mammal species is the short-tailed shrew (*Blarina brevicauda*). Larger and more mobile predator species are likely to have less contact with contaminated soils and other media at the site, but could be exposed to bioaccumulative chemicals present in prey species. As requested by DEQ (Port/DEQ correspondence, Appendix A), exposures of a representative raptor (red-tailed hawk [*Buteo jamaicensis*]) and predatory mammal (long-tailed weasel [*Mustela frenata*]) to bioaccumulative COIs were also estimated. These representative species were identified for this analysis because the exposure parameters are well-known and widely used in ecological exposure assessments (EPA 2007). Different species are likely present at the site, but the parameters used will result in an analysis that is protective of a broad range of species.

CPEC concentrations in soils also exceeded SLVs for invertebrates and plants at individual locations at the site. As indicated in Section 2.6.1.2, the locations are mapped in Figures 2-8 through 2-17 and no additional risk analysis was conducted for these receptors.

## 3.2 Problem Formulation for Expanded Exposure and Risk Calculations

According to DEQ guidance, the Problem Formulation should identify assessment endpoints that link the risk assessment to management concerns, and a CSM that describes key relationships between CPECs and assessment endpoint(s) and the analysis plan. The scope of the analysis is based on results of the screening analysis presented, and is intended to evaluate the potential risk from CPECs to terrestrial receptors at the Facility. The following summarizes the scope of the analysis approach.

### 3.2.1 Assessment Endpoints and Analysis Objectives

Small songbirds and mammals, such as mice, voles, and shrews, may spend all or most of their time at the Facility, feeding on vegetation and invertebrates that are in close contact with soils. Ground-feeding species with small home ranges represent the potentially most exposed ecological receptors. The American robin was identified as the representative avian receptor because it has relatively restricted feeding ranges during its time of residence at a site (i.e., high potential for exposure to site-specific conditions), and feeds on a variety of food items (i.e., vegetation and invertebrates) that could contact affected soils. Exposure for the American robin was estimated for both an entirely invertebrate diet (which best matches its diet during reproduction and rearing of young), and a more omnivorous diet that includes vegetation. Short-tailed shrews are primarily insectivorous, feeding mostly on adult and larval stages of a wide range of soil invertebrates. Shrews also have small home ranges, typically smaller than most of the EUs for the Facility (except Wharf Road EU). Other small mammals, such as mice and voles have similarly small home ranges, but have more omnivorous diets that include seeds and vegetative materials. Exposure to small mammals was estimated based on the body size, food ingestion rates, and other exposure parameters of short-tailed shrews (EPA

1993). Exposures were estimated for a diet comprised entirely of invertebrates and an omnivorous diet that includes vegetation.

The diet of the red-tailed hawk and long-tailed weasel was assumed to be entirely small mammals. Exposure parameters for both species are the same as those used in the EcoSSL analyses (EPA 2007). Individuals of both species certainly forage from areas larger than the EUs; and likely feed over areas that are larger than the entire Facility. Exposure estimations were conducted assuming that the proportion of food obtained the EUs is proportionate to the fraction of the home range size for each EU.

The following assessment endpoints were identified for the expanded analysis:

- Survival, growth, and reproduction of resident songbirds;
- Survival, growth, and reproduction of resident small mammals;
- Survival, growth, and reproduction of resident raptors with home ranges that include the Facility; and
- Survival, growth, and reproduction of resident mammalian predators with home ranges that include the Facility.

The overall goal of the analysis (i.e., the risk hypothesis) is to evaluate the potential exposure of the representative receptors beyond the screening-level approach defined above. The analysis includes estimation of exposure from ingestion of food and soils from the site, and comparison of the exposure estimate to intake-rate based Toxicity Reference Values (TRVs) that represent exposures that are assumed to be below unacceptable risk levels. The potential concentrations of CPECs in forage and prey items was estimated based on methods and bioaccumulation factors used by EPA in the EcoSSL development (EPA 2007). This is a deterministic evaluation conducted to evaluate the effects of assumptions about CPEC bioavailability and uptake into forage and prey items.

For some CPECs, probabilistic analysis based on robin and shrew populations was conducted to allow comparison to Oregon ARLs for non-T/E species (DEQ 2001). However, the sample size for surface soil samples available for some EUs at the Facility is small and did not allow reasonable interpretation of probabilistic analysis results.

## 3.3 Exposure and Risk Analysis Methods

The goal of the exposure and risk analysis is to estimate exposure of representative receptors to CPECs relative to ARLs for the local populations (for non-T/E species). The exposure and risk analysis was conducted using methods that are consistent with DEQ Level III guidance (DEQ 2001) and US EPA guidance (EPA 1997, 2007) for each of the EUs. The specific methods, exposure parameters, ecological benchmark values (EBVs), and risk characterization methodology are presented in the following sections.

### 3.3.1 Exposure Analysis Methods

The goal of the exposure analysis is to estimate the rate at which representative receptors are exposed to CPECs in the area under consideration, which is called the contaminated area (CA) in DEQ guidance. In this case, the EUs were evaluated separately. Estimating exposure for the endpoint receptor population requires defining exposure parameters (e.g., feeding range, body size, food ingestion rates) and estimating the EPC. Estimating the EPC, which is the concentration of a hazardous substance occurring at a location of potential contact between an ecological receptor and the hazardous substance, is the focus of an exposure analysis (DEQ 2001). The parameters used to calculate the EPC for the representative receptors are presented below.

#### 3.3.1.1 Exposure Estimation Model

Exposure of the representative wildlife receptor species was estimated by calculating the daily intake of CPECs that could be ingested with food and soil at the Facility. The equations and parameters used to calculate the estimated CPEC intake by the receptors, and the EBVs used to assess potential toxicity are shown in the following tables:

- American Robin: Table 3-1 (exposure parameters) and Table 3-2 (EBVs);
- Red-tailed Hawk: Table 3-3 (exposure parameters), Table 3-4 (small mammal uptake factors), and Table 3-5 (EBVs);
- Short-tailed Shrew: Table 3-6 (exposure parameters) and Table 3-7 (EBVs); and
- Long-tailed Weasel: Table 3-8 (exposure parameters), Table 3-9 (EBVs).

Standard dietary intake equations were used to estimate the amount of individual CPECs that a receptor could obtain from ingestion of plant and/or animal tissue. Daily rates for intake of forage, prey, water, and incidental ingestion of soils were obtained from the EPA, DEQ, and other state guidance (EPA 2007, WDOE 2012).

Since no site-specific data on biological tissue were available, CPEC concentrations in food were estimated using empirically derived uptake relationships from ecotoxicological literature (i.e., Bechtel-Jacobs 1998, Sample et al. 1998, Sample et al. 1999, EPA 2007). In addition to the ingestion of CPECs accumulated in food items, receptors may also be exposed to CPECs through the inadvertent ingestion of surface soil while foraging.

The home range or foraging area of the robin and shrew can be the same as or smaller than the individual EUs that DEQ has directed for use. As a result, the exposure estimates assume that individuals of these species, or the local subpopulation used in probabilistic risk estimates (see Section 3.3.2 below) obtain all of their food from the EU. The home ranges for the hawk and weasel are much larger, and individuals utilizing the Facility would have to feed over larger areas than any of the EUs, and the Facility overall. Therefore, an area use factor (AUF) was used to adjust the fraction of exposure from each EU compared to the overall area of home ranges.

The assimilation efficiency or bioavailability of CPECs in ingested soils or biota was conservatively assumed to be 100% for all ingested media. This is a conservative estimate since the bioavailability of most metals and organic chemicals is lower (e.g., Schoof 2003), especially directly from incidentally ingested soils or soils in gut content of prey items.

Concentrations of CPECs in soils were used within site-specific exposure models to estimate the EPCs. Appendix B presents the analytical results for CPECs in soils (to 4 ft bgs[3]) at the Facility. Figures 2-3 through 2-7 show soil sampling locations in each of the EUs. Analytical results were used to calculate 90UCLs using the EPA ProUCL computer program (EPA 2010, 2011). Appendix D summarizes CPEC concentrations in surface soils for each EU. For each CPEC, the tables show a detailed data summary, the MDC, and 90UCL of the mean concentrations. The tables for each receptor present a summary of EPCs for each of the EUs. Results based on both the discrete- and composite sample-based 90UCLs are presented. In addition, an estimate of exposure from regional

[3] Soil samples with an upper depth of less than 3 ft bgs and a bottom depth of less than 4 ft bgs were included in the evaluation.

background levels for metals was also calculated for comparison purposes. EUs with detected concentrations of mercury, Aroclors, pesticides, and/or PCDD/Fs were the focus of the bioaccumulative chemical analyses for the hawk and weasel receptors. Note that data on PCBs is based on analysis of individual Aroclor mixtures, and total Aroclors (or total PCBs) refers to the sum of detected Aroclors for a given sample or EU. PCDD/F results from the DEQ-directed incremental sampling of the three Wharf Road EU decision units in the Wharf Road EU are the focus of expanded risk analysis for PCDD/Fs.

### 3.3.2 Ecological Response Analysis

The ecological response analysis in the DEQ ERA guidance refers primarily to identification of exposure levels that correspond to levels of toxicity. The resulting values are called EBVs and are used to characterize the risk of adverse effects (see Section 4). Oregon rules identify ARLs for non-T/E species based on risk to populations. The population-level ARL has two elements: (1) a probability no greater than 0.1, that 20% or more of the local population experiences exposures greater than the EBV for a given chemical ($P_{20\%}$); and (2) there are no other observed significant adverse effects on the health or viability of the local population (DEQ 2001). The EBV for the ARL analysis is defined as the LD50 or LC50, or the exposure that results in about 50% mortality in the test population (DEQ 2001; OAR 340-122-115(6)).

The SLVs used in the Level II screen are based on levels of toxicity generally far lower than the LD50 or LC50. For most CPECs, a suitable LD50 or LC50 was not available to evaluate the ARL. Lowest-observed-affect-effect-level (LOAEL) values based on growth or reproduction represent lower risk than the LD50 or LC50. Therefore, use of the LOAEL in the exposure and risk estimates represents a more conservative estimate of risk to populations, and results can be used to infer the relationship of risk estimates to the ARL. Refer to Tables 3-2, 3-5, 3-7, and 3-9 for a list of the CPECs and EBVs that were used in the Level III risk estimation.

For the expanded Level II analyses, a toxicity quotient (TQ) was calculated as the ratio between the estimated exposure and the EBV (DEQ 2001):

$$TQ = \text{exposure estimate}/EBV$$

DEQ does not have specific guidance for interpreting the results of deterministic exposure analyses such as that shown for the 'expanded' Level II analysis. Interpretation of results depends, in part, on how conservative the exposure parameters are compared to those used to generate NOAELs and LOAELs. In ecological risk assessment context, NOAEL-based TQs equal to or less than 1.0 indicate that no adverse effects are expected (i.e., *de minimis* risk) and no further risk analysis is necessary to support site risk management decisions (see for example, EPA 1997). NOAEL TQs greater than 1 do not necessarily indicate unacceptable risk, but that additional risk analysis may be necessary to support risk management decisions. LOAEL TQs greater than 1 also may not necessarily equate to unacceptable risk, but indicate that sensitive individuals in a population may be affected. At exposures increasingly greater than the LOAEL, a greater number of individuals could be affected, and if exposures are high enough, or widespread enough, adverse impacts on populations could occur.

In the absence of T/E species, risk from a given CPEC was considered potentially unacceptable if exposure estimates exceeded the LOAEL EBVs (i.e., at TQ>1). This approach is consistent with EPA guidance and DEQ ARLs.

For some CPEC/EU combinations, a probabilistic analysis for the robin and shrew receptors was conducted to help evaluate risk. The analysis was based on the DEQ guidance for Level III ERA, and specifically to compare probability that 20 percent of a population has a 10 percent or greater chance of exceeding a LOAEL EBV ($P_{20\%}$). The same exposure parameters used in the deterministic analysis were used for the probabilistic analysis. Methods and results for this analysis are presented in Appendix E. Probabilistic analysis was not conducted for the hawk and weasel because the home ranges are large compared to the Facility, and populations would extend well beyond the assessment area.

Section 4 discusses the results of the expanded exposure and risk analyses separately for birds and mammals.

# 4.0 EXPOSURE ANALYSIS AND RISK CHARACTERIZATION RESULTS

The expanded Level II risk analysis for robin and shrew receptors was conducted for the CPECs identified in the Level II Screen for birds and mammals, as summarized on Tables 2-2 through 2-7. Risk from bioaccumulative COIs (i.e., mercury, PCBs, pesticides and PCDD/Fs) was evaluated for hawk and weasel receptors. Results of the expanded Level II exposure calculation and comparison to the EBVs are summarized on Table 4-1. The analyses are detailed for each of the EUs in Tables 4-2 through 4-11 for birds and Tables 4-12 through 4-21 for mammals. Risk from a given CPEC was considered potentially unacceptable if exposure estimates exceeded the LOAEL EBVs (i.e., at TQ>1). Results for the probabilistic analyses are presented in Appendix E and also discussed below.

## 4.1 Risk Characterization Results – Birds

Results of the expanded exposure and risk analysis for American robin and red-tailed hawk are summarized on Table 4-1 and shown in Tables 4-2 through 4-11. Exposure estimates for one or more of the CPECs identified in Table 4-1 exceeded LOAELs in the listed EUs. Results are discussed for each EU below. In general, the exposure estimates associated with insectivorous diet were higher than for the omnivorous diets. This is generally due to the higher uptake rates expected for invertebrates compared to plants.

### 4.1.1 West Parcel Upland EU

No CPECs were identified from the Level II screen for the American robin (Table 2-2 and Table 4-2). No exposures to mercury or Aroclors exceeded the NOAEL values for the red-tailed hawk (Tables 4-8 to 4-9).

### 4.1.2 Central Parcel Upland EU

Expanded exposure analysis for the American robin was conducted for copper, lead, and zinc in the Central Parcel EU. The bioaccumulative chemicals mercury and Aroclors were evaluated for the red-tailed hawk. Results for the American robin are shown in Table 4-3, and results for the red-tailed hawk are shown in Tables 4-8 through 4-9.

Expanded Level II copper exposure estimates for the robin exceeded the LOAEL EBVs for both discrete and composite sample types (Table 4-3). Level III probabilistic analysis conducted for copper indicates that risks may exceed the Level III ARL for non-T/E species (Appendix E-2-1, discrete and E-2-2, composite). The soil concentrations that corresponds to a TQs of 1 for an insectivorous diet are approximately 90 to 220 mg/kg for the LOAEL-based endpoints. Concentrations exceeding this level were observed at several locations in the EU.

Expanded Level II lead exposure estimates for the robin also exceeded the LOAEL EBVs for both discrete and composite sample types (Table 4-3). Level III probabilistic analysis conducted for the lead indicates that risks exceed the Level III ARL for non-T/E species (Appendix E-2-3, discrete and E-2-4, composite). The soil concentration that corresponds to a TQ of 1 for an insectivorous diet is about 34 mg/kg, which is substantially lower than the regional background concentration of 79 mg/Kg. Zinc exposures for the robin did not exceed the LOAEL, indicating that risks to birds from zinc exposure do not exceed acceptable levels (Table 4-3).

Exposure of red-tailed hawks did not exceed a TQ of 1 for metallic mercury or Aroclors (Tables 4-8 and 4-9). LOAELTQs were also calculated for methyl mercury, found to be <0.01 for both the discrete and composite samples (analysis not shown in Tables).

PCDD/Fs were initially detected in samples collected for the Source Control investigations of areas that are now primarily in the Central Parcel EU, but also border on the Inner Cove Beach EU and the Central Beach EU. At the direction of DEQ, risks from PCDD/Fs were primarily assessed based on composite sampling conducted in the Wharf Road EU in 2012 (See Section 4.2.6). However, PCDD/Fs were also included in the Level II screen for the Central Parcel EU because some individual sampling locations were located at the boundary between the Wharf Road EU and the Central Parcel EU. As listed on Table 2-3, concentrations of PCDD/Fs in the Central Parcel exceeded screening levels for birds and mammals. The screen results for the Central Parcel were based on WC-1 through WC-3 samples collected in 2010. As listed in Appendix B, PCDD/Fs were also detected at one location in the Inner Cove Beach EU (Wharf Beach -1) up to 1.5E-06 mg/kg for total TCDD TEQ and Central Beach EU (LW2-B015) up to 4.96E-07 mg/kg for total TCDD TEQ, but both of these results were below the approved SLV of 2.17E-05 mg/kg for birds and 2.3E-06 mg/kg for mammals.

Also, it should be noted that DEQ has since ordered additional MIS sampling of the entire Facility for use in characterizing site-wide PCDD/Fs concentrations. Results are likely to be available in spring 2014. Amendments to this risk analysis, if any, will be added after the data become available.

Section 4.2.6 summarizes the risk characterization for mammal exposure to PCDD/Fs in the Wharf Road EU.

### 4.1.3 East Parcel Upland EU

Expanded exposure analysis for the American robin was conducted for copper, lead, Aroclors, and zinc in the East Parcel EU. The bioaccumulative chemicals mercury, Aroclors, and DDT were evaluated for the red-tailed hawk. Results for the American robin are shown in Table 4-4, and for the red-tailed hawk in Tables 4-8 to 4-10.

Copper 90UCL concentrations for discrete and composite samples result in exposure estimates for the robin that exceed the LOAEL EBVs. Level III probabilistic analysis conducted for copper indicates that risks exceed the Level III ARL for non-T/E species (Appendix E-3-1, discrete and E-3-2, composite). The exceedance of the TQs was driven primarily by samples from a relatively small portion of the East Parcel EU. For both discrete and composite samples, data from the SSL riverbank samples were responsible for exceeding the LOAEL and the Level III ARL. Copper concentrations in all other samples were below 86 to 220 mg/kg, which is the concentration range that corresponds to a TQ of 1.0 for LOAELs and the insectivore diet.

Lead exposure for the robin also exceeded the LOAEL EBVs for both discrete and composite sample types, and Level III probabilistic analysis indicates that lead risks may exceed the Level III ARL for non-T/E species (Appendix E-3-3, discrete and E-3-4, composite). The soil concentration that corresponds to a TQ of 1 for an insectivorous diet is about 34 mg/kg, which is substantially lower than the regional background concentration of 79 mg/kg.

For total Aroclors, robin exposures exceeded a TQ of 1 when the EPC was based on composite samples (TQ = 14, n = 8), but not when it was based on discrete samples (TQ = 0.4, n = 15; Table 4-4). However, for composites, the TQ exceeded 1.0 only when samples from the Trench 1/2 and Trench 3/4 were included. These samples were not from surface soils, but were from depths of 8 to 8.5 ft bgs. The samples were included based on DEQ request since surface PCB samples were not available for the Trench areas (Port/DEQ correspondence, Appendix A). As a result, Aroclor exposure based on surface soil samples from the East Parcel do not appear to exceed acceptable risk levels.

Zinc exposures did not exceed the LOAEL for the robin, indicating that risks from zinc exposure do not exceed acceptable levels (Table 4-4).

Exposures of the red-tailed hawk did not exceed LOAEL TQ of 0.01 for mercury, Aroclors, or DDT (Tables 4-8 to 4-10). The LOAEL TQs for exposure to methyl mercury also did not exceed 0.01.

### 4.1.4 Inner Cove Beach EU

Expanded exposure analysis for the American robin was conducted for barium, copper, lead, mercury, zinc, and Aroclors for the Inner Cove Beach EU. The bioaccumulative chemicals mercury and Aroclors were evaluated for the red-tailed hawk. Results for the American robin are shown in Table 4-5, and for the red-tailed hawk in Tables 4-8 and 4-9. Barium and zinc exposures did not exceed the LOAEL for the robin, indicating that risks do not exceed acceptable levels. The copper 90UCL concentration for discrete samples results in exposure estimates for the robin that exceed the LOAEL EBV (TQ = 3.3). Probabilistic analysis using discrete samples indicates that the risk from copper exceeds the Level III ARL (Appendix E-4-1, discrete) but does not exceed for composite samples based on the LOAEL (Appendix E-4-2, composite). Since the Level III analysis was based on non-mortality endpoints, risks to robins in this EU do not appear to exceed the population ARL. A copper 90UCL could not be calculated for composite samples, but the maximum concentration among composites (130 mg/kg) did not exceed 223 mg/kg, which corresponds to an exposure TQ of 1.0 for insectivorous diets for birds. This suggests that risks from copper might not exceed acceptable levels in the Inner Cove Beach EU if composites are considered more representative of exposures than discrete samples.

The lead 90UCL concentration for discrete samples result in exposure estimates for the robin that exceeds the LOAEL EBVs. Probabilistic analysis indicates that the risk from lead exceeds the Level III ARL (Appendix E-4-3, discrete and E-4-4, composite) A lead 90UCL could not be calculated for composite samples, but two of the three composites samples exceeded 34 mg/kg (i.e., the soil concentration that corresponds to a TQ of 1 for a robin with insectivorous diet), but were from deep subsurface (8-8.5 ft bgs) samples collected from Trench 1/2 and Trench 3/4. Since mortality-based endpoints were not available for the lead analysis, and the high concentrations in composites were from deep subsurface samples, it is not clear whether risks from lead exceed acceptable levels.

The mercury 90UCL concentration for discrete samples result in exposure estimates for the robin that are equal to the LOAEL EBV (TQ 1.2 rounds to 1.0). Results for the American robin are shown in Table 4-5, and for the red-tailed hawk in Table 4-8. The highest concentrations in the Inner Cove Beach EU were from the Wharf Road beach area. Without these samples, the maximum concentration (0.24 mg/kg) corresponds to a TQ of approximately 1.5. Composite samples were available only from deep subsurface in the trench areas on the beach. These results suggest that mercury exposure is elevated, but the primary source of exposure in the exposure unit is relatively restricted in the Wharf Road beach sampling area.

The 90UCL for total Aroclor concentrations correspond to substantially elevated TQ values for the robin (Table 4-5). However, the high TQ values are almost entirely due to samples from the Trench 1/2 and 3/4 samples collected from eight ft bgs. These samples do not represent surface exposures, but were included at DEQ request because no surface samples were available from the trenched areas. Only one other detected concentration was observed from the exposure unit (0.0024 mg/kg), and corresponds to a TQ less than 1.0.

The bioaccumulative chemicals mercury, Aroclors, and DDT were evaluated for the red-tailed hawk. The LOAEL TQs for mercury and Aroclors were both below 0.01 (Table 4-8 and 4-9). Methyl mercury LOAEL TQs (not shown) were also below 0.01.

### 4.1.5 Central Beach EU

Expanded exposure analysis was conducted for cadmium for the Central Beach EU. The bioaccumulative chemicals mercury and pesticides were evaluated for the red-tailed hawk. Results for the American robin are shown in Table 4-6, and results for the red-tailed hawk are shown in Tables 4-8 and 4-10.

The MDC for cadmium did not result in exposures for the robin that exceeded the LOAEL for birds, indicating that risks to birds from cadmium exposure do not exceed acceptable levels.

The bioaccumulative chemicals mercury and pesticides (DDT, beta-endosulfan, beta-hexachlorocyclohexane, endrin, and total endosulfan) were evaluated for the red-tailed hawk. The LOAEL TQs for mercury and pesticides were all below 0.01 (Tables 4-8 and 4-10). Methyl mercury LOAEL TQs (not shown) were also below 0.01.

### 4.1.6 Wharf Road EU

TCDD TEQ was the only CPEC evaluated for the Wharf Road EU. Results are shown in Table 4-7. The Wharf Road EU is defined by the three multi-incremental sampling DUs developed for assessing the potential concentrations of PCDD/Fs in soils in the area formerly occupied by the access road from the upland area to the St. Johns dry docks. The area is small (~0.34 ac) and does not constitute an area large enough to support small birds or mammals. However, risk calculations were performed using the PCDD/F data from the DUs. The MDC and average concentration among the three DUs correspond to TQs greater than 1.0 for the robin (Table 4-7), but this assumes an AUF of 1.0. This is unlikely to be representative of a single robin home range, and is not representative of a subpopulation, so this risk estimate likely does not represent an unacceptable risk. However, additional PCDD/F sampling will be conducted at the Facility, and updated risks from PCDD/F will be provided when results are available. The Level II exposures for the red-tailed hawk did not exceed the LOAEL EBV (Table 4-11) and so does not represent unacceptable risk. Because of the small sample size and the small area, no probabilistic analysis was conducted for this EU.

## 4.2 Risk Characterization Results – Mammals

Results of the expanded exposure and risk analysis for short-tailed shrew and long-tailed weasel are summarized on Table 4-1 and shown in Tables 4-12 through 4-21. Exposure estimates exceeded LOAELs for one or more of the CPECs in all EUs except the West Parcel (Table 4-1). Results are discussed for each EU below.

### 4.2.1 West Parcel Upland EU

No CPECs were identified from the Level II screen for mammals (Table 4-12).

### 4.2.2 Central Parcel Upland EU

Expanded exposure analysis for the shrew was conducted for antimony, copper, lead, zinc, and high molecular weight PAHs (HPAHs) in the Central Parcel EU. Results of the Level II analysis are presented in Table 4-13. Exposure to the bioaccumulative chemicals mercury and Aroclors were evaluated for the long-tailed weasel (Tables 4-18 and 4-19).

For discrete samples, the 90UCL concentration for antimony in soils corresponds to a LOAEL TQ of about 2.7 for the shrew insectivore diet (1.4 for the omnivore diet). Composite samples are from the same riverbank sampling areas, but reflect a lower overall concentration and corresponding LOAEL TQs that are equal to or less than 1.0. As a result, although some discrete sampling locations exceed background, the overall concentration reflected in composite samples appears to result in exposures below the LOAEL. Level III probabilistic analysis (Appendix E-5-1, discrete; Appendix E-5-2, composite) showed that the $P_{20\%}$ of exceeding the LOAEL marginally exceeds 0.1 for the LOAEL EBVs for discrete samples, but is <0.1 for composite samples. Formal LD50 values are prescribed in the definition of the population-level ARL in Oregon rules, but were not available for use as EBVs for antimony. Since the LOAEL is based on non-mortality endpoints, and risk was acceptable based on composite samples, the risk from antimony is likely to be acceptable.

Copper exposure for the shrew exceeded the LOAEL EBVs for both discrete and composite sample types. Level III probabilistic analysis conducted for copper indicates that the $P_{20\%}$ exceeds 0.1 for LOAEL EBVs (Appendix E-5-3, discrete and E-5-4, composite). The soil concentration that corresponds to a TQ of 1 for an insectivorous diet is about 401 mg/kg. Concentrations exceeding this level were observed at several locations in the EU, but the highest concentrations were at TP-34 and riverbank sampling locations SSV and SSP.

Lead exposure for the shrew also exceeded the LOAEL EBVs for both discrete and composite sample types. Level III probabilistic analysis conducted for lead indicates that risks exceed the population-level Level III ARL (Appendix E-5-5, discrete and E-5-6, composite). The soil concentration that corresponds to a TQ of 1 for an insectivorous diet is about 129 mg/kg. Concentrations exceeding this level were observed at several locations in the EU.

Zinc exposures for the shrew exceeded the LOAEL for insectivore diet for both discrete and composite samples, but LOAEL TQs round to 1.0, and omnivore exposure correspond to TQs less than 1. The highest concentrations were associated with TP-34 and riverbank sampling locations SSS, SSV, and SSP. Overall, risk to mammals from zinc is relatively low in the Central Parcel EU.

HPAH exposures for the shrew exceeded the LOAEL for insectivore and omnivore diets for both discrete and composite samples. The composite TQ (2.3) is substantially lower than the TQ for discrete samples (10.2), suggesting that average exposures have much lower potential risk to small mammals. The overall concentration associated with a LOAEL TQ of 1.0 is approximately 5.6 mg/kg. Ten of the 33 locations sampled for HPAHs exceeded this value, and the locations are concentrated in one area of the EU, suggesting that a portion of the EU has potential for unacceptable risk.

The bioaccumulative chemicals mercury and Aroclors were evaluated for the long-tailed weasel. The LOAEL TQs for mercury and Aroclors were all below 0.06 (Tables 4-18 and 4-19). Methyl mercury LOAEL TQs (not shown) were below 0.4.

PCDD/Fs were initially detected in samples collected for the Source Control investigations of areas that are now primarily in the Central Parcel EU, but also border on the Inner Cove Beach EU and the Central Beach EU. For a summary of PCDD/Fs in the Central Parcel, see section 4.1.2. Section 4.2.6 summarizes the risk characterization for mammal exposure to PCDD/Fs in the Wharf Road EU.

### 4.2.3 East Parcel Upland EU

Expanded exposure analysis for the shrew was conducted for antimony, copper, lead, zinc, and Aroclors in the East Parcel EU. Potential bioaccumulation exposure and risk were evaluated for exposure of weasels to mercury, Aroclors, and DDT. Results are shown in Table 4-14 and Tables 4-18 through 4-20.

Antimony 90UCL concentrations for discrete and composite samples result in exposure estimates that exceed the LOAEL EBVs for both the insectivore and omnivore diets. Level III probabilistic analysis indicates that $P_{20\%}$ exceeds 0.1 for the LOAEL EBVs (Appendix E-6-1, discrete and E-6-2, composite). The exceedance of the TQs and the Level III ARL was driven primarily by samples from the SSL riverbank samples and samples from Trench 1/2 and Trench 3/4, which are not from surface soils, but were from depths of 8 to 8.5 ft bgs. Antimony concentrations in all other samples were below 2.7 mg/kg, which is the concentration that corresponds to a TQ of 1.0 for the insectivore diet.

Copper 90UCL concentrations for discrete and composite samples result in exposure estimates that exceed the LOAEL EBVs for both the insectivore and omnivore diets. Level III probabilistic analysis conducted for copper indicates that $P_{20\%}$ exceeds 0.1 for the LOAEL EBVs (Appendix E-6-3, discrete and E-6-4, composite). The exceedance of the TQs and the Level III ARL was driven only by very elevated concentrations in the SSL riverbank samples. Copper concentrations in all other samples were below the 400 mg/kg concentration that corresponds to a TQ of 1.0 for the insectivore diet.

Lead exposure also exceeded the LOAEL EBVs for both discrete and composite sample types. Level III probabilistic analysis indicates that $P_{20\%}$ for lead exceeds 0.1 for the LOAEL EBVs (Appendix E-6-5, discrete and E-6-6, composite). The soil concentration that corresponds to a TQ of 1 for an insectivorous diet is about 129 mg/kg. Concentrations exceeding this level were observed at several locations in the EU.

For Aroclors, exposures exceeded a TQ of 1 for the shrew based on discrete and composite samples. However, the EPCs include samples from Trench 3/4, which is not from surface soils, but were from depths of 8 to 8.5 ft bgs. The samples were included based on DEQ request since surface PCB samples were not available for the Trench areas (Port/DEQ correspondence, Appendix A). When this sample is excluded from the data set, TQs are less than 2.0.

Zinc exposures exceeded the LOAEL for insectivore diet for both the discrete and composite samples, but the TQs were relatively low from 1.3 to 1.5. The omnivore diet TQs were less than 1.0 for both discrete and composite samples. The highest concentrations were associated with the riverbank sampling locations in the SSL area. Overall, risk to mammals from zinc is relatively low in the East Parcel EU.

The bioaccumulative chemicals mercury, DDT, and Aroclors were evaluated for the long-tailed weasel. The LOAEL TQs for mercury and DDT were all well below 0.01 (Tables 4-18 and 4-20). Methyl mercury LOAEL TQs were also well below 0.01. Weasel exposures for Aroclor 1260 (but not 1254) and total Aroclors exceeded a LOAEL TQ of 1.0 (Table 4-19). For total Aroclors, the LOAEL TQ exceeded 1 for composite, but not discrete values. The uncertainty regarding use of the subsurface samples to represent exposures is the same as for the shrew.

### 4.2.4 Inner Cove Beach EU

Expanded exposure analysis was conducted for antimony, copper, lead, Aroclors, HPAHs, and zinc in the Inner Cove Beach EU. Potential bioaccumulation exposure and risk were evaluated for exposure of weasels to mercury and Aroclors. Results are shown in Table 4-15 and Tables 4-18 and 4-19.

The antimony 90UCL concentration for discrete samples results in exposure estimates that exceed the LOAEL EBVs for both the insectivore and omnivore diets. Level III probabilistic analysis indicates that $P_{20\%}$ for antimony exceeds 0.1 for the LOAEL EBV (Appendix E-7-1, discrete and E-7-2, composite). Two of the three composite samples available for the EU were from deep subsurface samples (8-8.5 ft bgs). The exceedance of the TQs and the Level III ARL was driven primarily by samples from the Beach Cove-1 location (154 mg/kg).

The copper 90UCL concentration for discrete samples results in exposure estimates that exceed the LOAEL EBV for insectivorous (TQ = 1.9), but not the omnivorous diet. Level III probabilistic analysis indicates that $P_{20\%}$ for copper exceeds 0.1 for the LOAEL EBVs (Appendix E-7-3, discrete and E-7-4, composite). A 90UCL could not be calculated for composite samples, but the maximum concentration among composites (130 mg/kg) did not exceed 400 mg/kg, which is the concentration that corresponds to an exposure TQ of 1.0 for insectivore diets for small mammals.

The lead 90UCL concentration for discrete samples results in exposure estimates that exceed the LOAEL EBVs. Probabilistic analysis using discrete samples indicates that the $P_{20\%}$ exceeds 0.1 (Appendix E-7-5, discrete and E-7-6, composite). Four of the ten discrete samples were either equal to or greater than the 129 mg/kg concentration that corresponds to an exposure TQ of 1.0 for insectivore diets for small mammals. The three composite samples available for the

EU ranged from 30 to 137 mg/kg, but two of the samples were from deep subsurface samples (8-8.5 ft bgs) and do not represent a complete exposure pathway.

The 90UCL for total Aroclor 1254 and total Aroclor concentrations correspond to substantially elevated TQ values for the shrew (Table 4-15), and for the weasel (Table 4-19). As described for bird exposure in this EU, the high TQ values are almost entirely due to samples from trenches at eight ft bgs. These samples do not represent surface exposures, but were included at DEQ request because no surface samples were available from the trenched areas. Only one other detected concentration was observed from the exposure unit (0.0024 mg/kg), and corresponds to a TQ less than 1.0. The highest concentrations were associated with the shoreline sampling adjacent to the Wharf Road area.

HPAH exposures exceeded the LOAEL for the insectivore diet, but not the omnivore diet, for discrete samples. Two of the three composite samples available for the EU were from deep subsurface samples (8-8.5 ft bgs), and no UCL was calculated for these samples. The overall concentration associated with a LOAEL TQ of 1.0 is 5.6 mg/kg. None of the composite samples exceeded this concentration, while two of the six discrete samples exceeded it.

Zinc exposures exceeded the LOAEL for insectivore diet for discrete samples, but the TQ was 1.3 indicating relatively low risk. The omnivore diet TQs were less than 1.0 for discrete samples. The highest concentrations were associated with the shoreline sampling adjacent to the Wharf Road area.

The bioaccumulative chemicals mercury and Aroclors were evaluated for the long-tailed weasel. The LOAEL TQs for mercury were below 0.001 (Tables 4-18). Methyl mercury LOAEL TQ was also below 0.2. As noted above, weasel exposures for Aroclor 1254 (but not 1260) and total Aroclors exceeded a LOAEL TQ of 1.0 (Table 4-19). However, the uncertainty regarding use of the subsurface samples to represent exposures is the same as for the shrew.

### 4.2.5 Central Beach EU

Expanded exposure analysis was conducted for cadmium in the Central Beach EU. The bioaccumulative chemicals mercury and pesticides were evaluated for the long-tailed weasel.

Results for the shrew are shown in Table 4-16, and results for the long-tailed weasel are shown in Tables 4-18 and 4-20.

No UCL was calculated for cadmium in this EU. The MDC for cadmium corresponds to exposures that exceeded the LOAEL for the shrew with an insectivore diet, but not the omnivore diet, with a TQ of 1.7 (Table 4-16). All other detected cadmium concentrations were below background.

The bioaccumulative chemicals mercury and pesticides (DDT, beta-endosulfan, beta-hexachlorocyclohexane, endrin, and total endosulfan) were evaluated for the long-tailed weasel. The LOAEL TQs for mercury and pesticides were all well below 0.01 (Tables 4-18 and 4-20). Methyl mercury LOAEL TQ was also below 0.2.

### 4.2.6 Wharf Road EU

Consistent with birds, TCDD TEQ was the only CPEC evaluated for the Wharf Road EU. The Wharf Road EU is defined by the three multi-incremental sampling DUs developed for assessing the potential concentrations of PCDD/Fs in soils in the area formerly occupied by the access road from the upland area to the St. Johns dry docks. The area is small (~0.34 ac) and does not constitute an area large enough to support small mammals or other wildlife. Risk calculations were performed using the PCDD/F data from the DUs. The MDC and average concentration among the three DUs correspond to TQs greater than 1.0 for the shrew (Table 4-17) and weasel (Table 4-21). Additional PCDD/F sampling will be conducted at the Facility, and updated risks from PCDD/Fs will be provided when results are available. Because of the small sample size and the small area, no probabilistic analysis was conducted for this EU.

## 4.3 Hot Spot Analysis

Highly concentrated hot spot levels based on non-T/E species were calculated in accordance with DEQ guidance (DEQ 1998, 2001) for each of the chemicals identified in the Level II screen (as summarized on Tables 2-2 through 2-7). Table 4-22 shows generic high concentration hot spot levels calculated for the relevant chemicals, based on values that correspond to 10- or 50-

times the lowest Level II SLV for ecological receptors[4]. For chromium, the projected high concentration hot spot value was less than the corresponding background concentration. In this case, the lowest SLV-based hot spot value that was higher than background was chosen. Figure 4-1 shows the sampling locations at which concentrations of one or more COIs exceed the hot spot concentrations.

## 4.4 Uncertainty Analysis

There are many sources of potential uncertainty in the ERA process. The risk analysis presented here is based largely on estimating exposure of receptors to COIs based on site soil data, and estimating toxicity based on literature studies values. The uncertainty in ERAs of this type is mainly associated with the assumptions used in the exposure analysis.

<u>Exposure Assessment Sources of Uncertainty:</u>

- *Estimating soil EPCs:* EPCs are estimated based on soil samples that were collected during the RI/FS and subsequent sampling events to characterize the nature and extent of contamination. In most cases, sampling was focused on parts of the site where contamination was suspected based on historic activities. In these cases, the parts of the site where contamination is highest are likely to be over-represented, resulting in potential over-estimation of EPCs and risks.

  The list of chemicals analyzed in soil samples was not the same for all parts of the site. Analytes were identified based on the past activities and the types of chemicals expected in the areas. In these cases, data for analytes is not consistently represented among EUs, or between areas within the EUs. This factor could result in over- or under-estimates of risk.

  The site was characterized using both composite and discrete sample analysis. In some cases, samples were composited among varying number of sampling locations and between different sampling types. In the calculation of 90UCLs and in the Expanded

[4] Hot spot values were based on DEQ-approved Level II SLVs summarized on Table 2-1. Values based on NOAEL are 50-times the SLV for high concentration hot spot values; values based on LOAELs are 10-times the SLV for high concentration hot spot values.

Level II analysis, EPCs calculated from composite and discrete samples are shown separately. In the cases where there were not sufficient sample numbers to calculate a 90UCL, the MDC was provided. This factor could over-estimate risk.

Test pit composite samples collected during the RI (e.g., A121, A123, etc.), are samples that were combined from at least two test pit locations. In many of the composites, subsamples were taken from soils that are deeper than the established depth intervals. In many cases, the test pits are represented in the discrete data from known surface depth intervals. Some of the test pit composites contained subsamples from different EUs, and several include subsamples that were in the Lead Removal Action Area in the Central Parcel. These sample results were not included in the initial exposure estimates because discrete samples from the test pits were often available and other samples from the EU provided data that are more appropriate for the UCL calculations. Appendix F provides more information about these test pit composite samples and the screening analyses based on test pit composite samples, versus using other samples from the EUs to perform screening analyses and estimate EPCs.

Several of the test pit composites contain subsamples from pits that were located in the Lead Removal Action Area (RAA) in the Central Parcel. When samples from inappropriate depths or from the RAA are excluded, only four remain: two composite test pit samples that include subsamples from the West and Central Parcels, one composite sample from test pits only in the Central Parcel, and one composite sample from test pits only in the East Parcel (Table F-1).

In general, results and conclusions of the RERA are not substantially affected by exclusion of the test pits in the data sets. The results of the comparisons are summarized below.

**West Parcel:**

Antimony was not detected in other samples from the West Parcel, but was detected in the only test pit sample. The concentration in the composite was 30 mg/kg, which corresponds to a TQ >5 for plants and mammals. However, because antimony was not detected at other locations, a UCL90 cannot be calculated for the parcel.

The test pit sample has a higher concentration of chromium (22 mg/kg) than other West Parcel samples (20.6 mg/kg), but is still less than background (76 mg/kg). As a result, chromium would not have been identified as a CPEC.

The test pit sample has a higher concentration of copper (55 mg/kg) than other West Parcel samples (31 mg/kg), and is higher than background (34 mg/kg). However, this concentration does not correspond to a TQ > 5 for any receptor group, and so would still not be a CPEC.

**Central Parcel:**
Antimony was the only analyte detected at a slightly higher concentration in the test pit sample (22 mg/kg vs 20 mg/kg). The higher concentration would not affect the identification of CPECs or COCs for the EU.

**East Parcel:**
The East Parcel included one test pit composite, which was analyzed only for PAHs. HPAH concentration in the test pit composite was 18.1 mg/kg, compared to a maximum of 4 mg/kg in other composites. When the test pit composite is included, the 90UCL is 11.1 mg/kg, compared to 3 mg/kg when the test pit composite is excluded. The 90UCL would result in HPAHs being identified as CPEC based on the Level II screening assessment for the East Parcel EU. The Expanded Level II exposure analysis would result in a LOAEL-based TQ of 1.1 for the mammal omnivore diet, and a TQ of 2 for the insectivore diet. Based on these results, inclusion of the test pit composite would result in addition of HPAHs to the CPECs for the East Parcel, but relatively low LOAEL-based TQs in the exposure assessment.

- *Estimating uptake of COIs into biota:* Since no biota data collection was undertaken at the Facility, the uptake of COIs into biota was estimated to support exposure analysis based on ingestion of plants or animals from the site. The methods used to estimate uptake and ingestion were based on those use by EPA or other agencies to calculate screening levels. This includes the food and soil intake rates by the representative receptors, assuming 100% bioavailability of ingested COIs, the diets of the receptors, and the assumption that the populations or individuals obtain all food from the Facility. Screening level calculation is generally intended to minimize the chance of underestimating exposure and risk, so the methods used tend toward higher estimates of uptake and ingestion. Therefore, this factor is likely to overestimate exposure and risk.

- *Removal Action Area:* The metal RAA in the Central Parcel contains nine sampling locations which were all included in calculating the UCL90 for the Central Parcel. A DEQ comment indicated that the RAA may be over-represented in the UCL90 estimate because of the higher density of samples from a relatively small area. The uncertainty was assessed by recalculating the Central Parcel 90UCL for soils concentrations for copper, lead, mercury, and zinc using the average concentration from the RAA as a single value representing that area. Results show that the 90UCL values increased for copper (18%), lead (16%), mercury (14%), and zinc (4%). The Central Parcel TQs for the metals increased by the same amounts, but the overall conclusions of the risk assessment were comparable.

- *Detection Limits:* For some chemicals, uncertainty is encountered because the detection frequency for soil analyses was 0%, but the maximum detection limit exceeded the SLV. These chemicals are unlikely to represent unacceptable risk at the site, but the uncertainty should be acknowledged. These chemicals are shown in Tables 2-2 through 2-7. For other chemicals, the MDC did not exceed SLVs, but the maximum detection limit for non-detected results was higher than SLVs (Table D-7-1, Appendix D). This results from variable detection limits among the investigations from which data were used in the screen. These chemicals are also unlikely to represent unacceptable risk.

Toxicity Assessment Sources of Uncertainty:

- *SLVs and EBVs:* SLVs were identified by DEQ to represent concentrations below which no adverse effects are expected. To help ensure this assumption, SLVs are generally chosen to minimize the chance that risk is underestimated. EBVs were identified for the Expanded Level II and Level III analysis from compilations of toxicity data that have been extensively reviewed (Sample et al. 1996, EPA 2007). NOAEL-based EBVs were selected to represent levels at which no adverse effects are expected. LOAEL-based

EBVs were intended to represent a range of effects on reproduction or growth. As noted in Section 4, the population-based ARL is based on mortality-based endpoints. As a result, the use of LOAEL EBVs likely underestimates the chance of exceeding ARLs based on Oregon rules.

- *Lack of SLVs or other Toxicity Assessment Information:* The overall list of chemicals that were analyzed in samples collected from the Facility is large, and SLVs were not available for all chemicals. Because the risk from these chemicals cannot be quantified, DEQ considers them as potential COCs. The COIs for which SLVs were not available for at least one receptor are shown in Table 2-8.

# 5.0 CONCLUSIONS AND RECOMMENDATIONS

Extensive investigations of soils and groundwater at the Facility indicate that some areas of the site contain elevated concentrations of metals, HPAHs, Aroclors, and PCDD/Fs. A summary of the COCs is shown in Table 5-1, and is based on results of the Level II screening (Tables 2-2 through 2-7) and the Expanded Level II analysis (Table 4-1).

For plants and invertebrates, CPEC concentrations in soils exceed DEQ SLVs at multiple sampling locations. Except for the eastern Central Parcel, locations with concentrations exceeding SLVs are widely dispersed and do not represent contiguous areas where a significant portion of the habitat is affected. In addition, elevated concentrations of metals (lead, mercury) are located at the shoreline areas in the downstream portion of the Inner Cove Beach EU. However, these sampling locations are near or at low water line and are inundated much of the time. Qualitative observations in these areas reveal that no permanent plant or soil invertebrates are present, probably due to the natural effects of inundation and wave action. Therefore, risk management action in these areas to protect upland plants and/or invertebrates would not be effective in reducing risk.

Without site-specific toxicity testing for plants or invertebrates, conclusions about the relative risk to these groups is uncertain, especially if assessing overall ecological function. As noted in Section 2, no overtly phytotoxic areas were observed on site visits. Soil conditions including pH, organic carbon content, texture and other factors are known to affect bioavailability and toxic potential. Overall, data suggest that soil CPEC concentrations may be toxic to plants or invertebrates at some locations, but the overall effect on populations or communities, or the corresponding function are not known. For this reason, the use of Level II SLVs for assessing the potential for ecologically meaningful adverse effects on plants and invertebrates should be considered highly conservative. Elevated CPEC concentrations in soils can lead to increased uptake into plants and invertebrates, and subsequent exposure to wildlife that feed on them. No data on CPEC concentrations in biota were available, so empirical uptake equations from the scientific literature were used to estimate potential biotic uptake of CPECs. Extrapolation from literature-based equations represents a significant source of uncertainty in estimating exposure and risk. The literature equations are typically developed for screening-level purposes and intended to provide high-end estimates of uptake to minimize the little chance of underestimating exposure.

Elevated concentrations of copper and lead were the most widespread among the EUs. Potential risks from copper and lead were the most prevalent and widespread for both birds and mammals (Table 4-1). Elevated antimony concentrations also result in potentially unacceptable risk for mammals in the Central Parcel, East Parcel, and Inner Cove Beach EUs. For the Inner Cove Beach EU, the metals mercury, vanadium and zinc were present at levels that could result in unacceptable risk for mammals and/or birds.

Exposure of birds and mammals to Aroclors was also potentially unacceptable in the East Parcel EU and Inner Cove Beach EU. However, the highest concentrations of Aroclors were detected in subsurface (8-8.5 ft bgs) samples in the Trench 1/2 and 3/4 sampling locations. These samples were included in the risk analysis at DEQ's request because no Aroclor results were available for surface soils in these sampling areas. When these samples are excluded from the exposure analysis, the remaining Aroclor concentrations correspond to TQs above 1.0 but less than 2.0, indicating relatively low risk.

Except for copper and lead, 90UCL-based estimates of exposure exceeds the EBVs primarily due to a few locations with exceptionally high concentrations. In several cases, the most elevated concentrations are from samples that are in close proximity to each other. Examples include PCBs from the Trench samples cited above; PCDD/Fs and PCBs in Riverbank sampling areas SSS, SSL, SSV; and mercury, copper, and lead in the shoreline sampling locations in the downstream part of the Inner Cove Beach EU. In most cases, sampling has been focused on the areas suspected of contamination, so the more highly sampled areas are overrepresented in the exposure calculations, and the risk calculation is not representative of habitats throughout the EU.

Exposure estimates for upland songbirds and small mammals in the Central Beach and Inner Cove Beach EUs may not be representative of actual exposures for several reasons, but primarily that there are no habitat or food resources for such species in aquatic areas. The PH-BERA includes risk analysis for wading birds in both of these areas. The PH-BERA analysis does not include upland samples collected for the Willamette Cove Facility; analysis was conducted using composite soil samples collected along the beaches in areas typical of where wading birds feed. No unacceptable risks were identified for the Central Beach area. Exposure to PCB and copper risks exceeded LOAEL benchmarks in the Inner Cove Beach area. However, the exposure estimates for the PH-BERA were based on chemical concentrations in aquatic invertebrate samples collected from within the Willamette River. As a result, the sources of copper and PCBs in the invertebrates cannot be attributed to the Willamette Cove Facility.

Sampling to characterize PCDD/F concentrations was focused on the Wharf Road EU, which was separated from the Central Parcel EU explicitly for evaluating the PCDD/F exposure. DEQ requested that composite samples collected by multi-incremental sampling methods be obtained from three Wharf Road EU decision units to support the risk analysis for that area. As agreed, the maximum and average of the DUs was used in the exposure analysis and correspond to TQs substantially greater than 1 for all receptors. Discrete samples collected from the same area prior to the incremental sampling show similar and higher PCDD/F concentrations. Based on the detected PCDD/F concentrations, the DEQ has requested further characterization of the nature and extent of PCDD/F in upland surface soil (DEQ, 2013a). Results are likely to be available in spring 2014.

Avian and/or mammalian predators could visit the Facility and may ingest prey captured from the areas. However, the home range required to support individual of representative species used in the analysis – red-tailed hawk and long-tailed weasel – are larger than the Facility, and much larger than the individual EUs. As a result, individuals would likely obtain a relatively small fraction of food resources from each EU. Therefore, exposure of these predators to site COPECs is not likely to exceed those for the robin or shrew receptors used to evaluated resident wildlife. However, upper trophic-level predators could be disproportionately exposed to bioaccumulative chemicals from the site because such chemicals can become bioconcentrated in biota from the site. The LOAEL TQs for the hawk and weasel were generally less than 0.01 for bioaccumulative chemicals from most EUs, indicating the risk of toxic exposure is negligible. The TQs for Aroclors from the East Parcel EU and the Inner Cove Beach EU did exceed 1, but this was primarily due to exposure estimates that included high concentrations in samples collected from deep subsurface soils that do not represent complete exposure pathways for any of the receptors. DEQ requested that these samples be included in the initial exposure estimate because surface samples were not available for these locations. However, since these data are the only indication of exposures that approach TQ of 1, risk to individual predators is likely negligible, and risk to predator populations is almost certainly *de minimis.*

Based on the results presented in this RERA, ecological receptors at the Facility could experience toxic exposures to CPECs if they spend enough time in areas of the highest concentrations. If the exposure and risk is determined to be unacceptable, focused remedial action in areas of high concentrations could lower exposure estimates to levels that would be below Oregon ARLs. Consistent with Oregon statute, a Feasibility Study (OAR 340-122-0085) is recommended to help determine whether remediation or other risk management actions would be effective in reducing risk at the site.

## 6.0 REFERENCES


Alta Planning and Design. 2010. Willamette Cove, Trail Alignment Refinement Report. http://www.portlandonline.com/parks/index.cfm?a=284925&c=51823. (Rev. January 28).

Ash Creek Associates/Newfields (ACA/NF). 2007. Addendum to Riverbank Soil Sampling, Work Plan, Willamette Cove Upland Facility, August.

Ash Creek Associates (ACA). 2007. Removal Action Work Plan, Willamette Cove Upland Facility, September 27.

Ash Creek Associates (ACA). 2008. Addendum to Removal Action Work Plan, Willamette Cove Upland Facility, June 5.

Ash Creek Associates/Newfields (ACA/NF). 2008a. Riverbank Soil Sampling Addendum, Willamette Cove Upland Facility, October 29.

Ash Creek Associates/Newfields (ACA/NF). 2008b. Removal Action Report, Willamette Cove Upland Facility, December.

Ash Creek Associates (ACA). 2010a. Source Control Sampling Work Plan, Willamette Cove Upland Facility, March 31.

Ash Creek Associates (ACA). 2010b Source Control Sampling Work Plan Addendum, Willamette Cove Upland Facility, September 2.

Ash Creek Associates (ACA). 2011. 2010 Source Control Sampling Results, Willamette Cove Upland Facility, May 6.

Ash Creek Associates (ACA). 2012. 2012 Surface Soil Sampling Results-Former Wharf Road Area, Willamette Cove Upland Facility, October 17.

Bechtel-Jacobs. 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. Bechtel-Jacobs Company LLC, Oak Ridge, TN. BJC/OR-133.

Blasland, Bouck, and Lee, Inc. /Ash Creek Associates/NewFields (BBL/ACA/NF). 2005a. Groundwater Monitoring Report – Third Quarter 2005, Willamette Cove Upland Facility. November.

Blasland, Bouck, and Lee, Inc. /Ash Creek Associates/NewFields (BBL/ACA/NF). 2005b. Riverbank Soil Sampling Work Plan, Willamette Cove Upland Facility. December.

Blasland, Bouck, and Lee, Inc. /Ash Creek Associates/NewFields (BBL/ACA/NF). 2006a. Groundwater Monitoring Report – December 2005, Willamette Cove Upland Facility. April 21.

Blasland, Bouck, and Lee, Inc. /Ash Creek Associates/NewFields (BBL/ACA/NF). 2006b. Riverbank Soil Sampling Report, Willamette Cove Upland Facility. May 5.

City of Portland. 1999. Willamette Cove Management Plan Draft. Bureau of Parks and Recreation. May 25.

City of Portland. 2000. Draft Willamette River Inventory: Natural Resources. Bureau of Planning, Public review draft, August.

City of Portland. 2001. Parks 2020 Vision. Bureau of Parks and Recreation. July.

City of Portland. 2004. Zoning Maps. Available at http://www.portlandonline.com/planning/. Map 2222 revised 07/10/2004; downloaded 04/04/2006.

City of Portland. 2004. Bureau of Planning Zoning Map 2222. http://www.portlandoregon.gov/bps/index.cfm?c=35101&a=55474. July 10.

City of Portland. 2012. Significant Scenic Resources - CON-05. http://www.portlandoregon.gov/bps/article/400445.

Ecology and Environment. 2000. Draft Biological Evaluation, McCormick & Baxter Creosoting Company, Portland, Oregon. January.

Formation Environmental (Formation). 2012a. Letter to Ken Thiessen from Formation Environmental. Re: Response to DEQ December 20, 2011 Letter, Willamette Cove Upland Facility Residual Risk Assessment. Prepared by Formation Environmental for Ash Creek Associates on behalf of Port of Portland (Portland, OR). February 3.

Formation Environmental (Formation). 2012b. Letter to Ken Thiessen from Formation Environmental. Re: Response to DEQ March 2, 2012 Letter, Willamette Cove Upland Facility Residual Risk Assessment. Prepared by Formation Environmental for Ash Creek Associates on behalf of Port of Portland (Portland, OR). June 20.

Formation Environmental (Formation). 2013. Letter to Kenneth Thiessen from Formation Environmental re: comments on "Draft Residual Human Health and Ecological Risk Residual Assessments Willamette Cove Upland Facility. ECSI# 2066”. (July 19, 2013). October 2013.

Efroymson, R.A., G.W. Suter II, B.E. Sample, and D.S. Jones. 2003. Preliminary remediation goals for ecological endpoints. ES/ER/TM-162/R2. Prepared or the U.S. Department of Energy, Office of Environmental Management. August.

Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: A synoptic review. Contaminant Hazard Reviews, Report No. 11.; Biological Report 85(1.11). U.S. Fish and Wildlife Service, Laurel, MD. May.

Hahn and Associates. 1999. Underground Storage Tank Decommissioning Report, Willamette Cove Property, North Richmond Street, Portland Oregon. August 13.

Hart Crowser. 2000. Existing Data/Site History Report, Willamette Cove, Portland, Oregon. November 8.

Hart Crowser. 2003. Remedial Investigation (Volume I), Willamette Cove, Portland, Oregon, ECSI No. 2066. Prepared for Port of Portland/Metro, Project No. 23998, Task No. 730. March 11.

Kappleman, W.B. 1993. Pine Street Canal Ecological Assessment: A Case Study. In: Maughan, J.T., Ecological Assessment of Hazardous Waste Sites. Van Nostrand Reinhold, New York.

Marquenie, J.M., J.W. Simmers, and S.H. Kay. 1987. Preliminary assessment of bioaccumulation of metals and organic contaminants at the Times Beach Confined Disposal Site, Buffalo, N.Y. U.S. Army Corps of Engineers Miscellaneous Paper EL-87-6.

NewFields/Ash Creek Associates/Newfields (NF/ACA). 2007. Willamette Cove Baseline Risk Assessment, Willamette Cove Upland Facility (DRAFT), August 23.

Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final April 1998, updated May.

Oregon Department of Environmental Quality (DEQ). 2006b. Guidance for Conducting Feasibility Studies. Final.

Oregon Department of Environmental Quality (DEQ). 2010. Letter to Kelly Madalinski, Port of Portland from Kenneth Thiessen, Oregon DEQ. “Re: DEQ Request for Residual Risk Assessment and Data Requirements for Completion of Uplands and Source Control Site Characterization. Willamette Cove, ECSI 2066.” Oregon Department of Environmental Quality, January 15.

Oregon Department of Environmental Quality (DEQ). 2011. Letter to Dwight Leisle from Kenneth Thiessen. “Re: Response to Proposed Approach for Willamette Cove Upland Facility Residual Risk Assessment, dated November 28, 2011. ECSI #2066.” Oregon Department of Environmental Quality, December 20.

Oregon Department of Environmental Quality (DEQ). 2012a. Letter to Dwight Leisle from Kenneth Thiessen. Re: Resubmission and corrected response letter: Comments on February 3, 2012 letter entitled: *Response to DEQ December 20, 2011 Letter Willamette Cove Upland Facility Residual Risk Assessment, ECSI #2066*. Oregon Department of Environmental Quality, March 16.

Oregon Department of Environmental Quality (DEQ). 2012b. Letter to Dwight Leisle from Kenneth Thiessen. Re: DEQ Approval of Willamette Cove Upland Facility Residual Risk Assessment, final planning letter date June 20, 2012. ECSI #2066. Oregon Department of Environmental Quality, July 5.

Oregon DEQ (Oregon Department of Environmental Quality). 2013a. Letter from Kenneth Thiessen (Oregon DEQ) to Dwight Leisle (Port) re: comments on "Draft Residual Human Health and Ecological Risk Residual Assessments Willamette Cove Upland Facility. ECSI# 2066". July 19, 2013.

Oregon Department of Environmental Quality (DEQ). 2013b. Development of Oregon Background Metals Concentrations in Soil. Technical Report. Land Quality Division Cleanup Program. March 2013.

Oregon State University. Oregon State University, Oregon Weather and Climate Data Website. (www.ocs. orst. edu).

Oregonian. 1904. Has Japanese Exhibit Portland And Asiatic Liner, Indravelli, Arrives, p. 14, March 3.

Oregonian. 1919. Coal Dock is in Service. Business of Supplying Ships in Harbor Begun. Considerable Quantities of Fuel Already, p. 22, May 25.

Oregonian. 1967. Flakewood Fire. October 14.

Port of Portland. 2003. Final Draft Remedial Investigation Addendum: Supplemental Preliminary Assessment of the Willamette Cove Upland Facility. September 19.

Portland and Seattle Railway. 1906. Willamette River Bridge at Portland, Exhibit No. 17, submitted by Port of Portland Bridge Committee, February 19.

PTI Environmental Services. 1992. Remedial Action Report, McCormick & Baxter Creosoting Company. September.

Sample B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II, and T.L. Ashwood. 1999. Literature-derived bioaccumulation models for earthworms: development and validation. Environmental Toxicology and Chemistry 18: 2110-2120.

Sample, B.E., D.M. Opresko, and G.W. Suter, II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Risk Assessment Program, Health Sciences Research Division, Oak Ridge, TN. Publication ES/ER/TM-86-R3.

Schoof, R.A. 2003. Guide for Incorporating Bioavailability Adjustments into Human Health and Ecological Risk Assessments at U. S. Department of Defense Facilities Part 1: Overview of Metals Bioavailability (Final).

Sweet Edwards/EMCON, Inc. 1989. Level II Environmental Site Assessment, St. Johns Riverfront Property, Portland, Oregon. March 15.

Sweet Edwards/EMCON, Inc. 1996. Supplemental Environmental Site Assessment, St. Johns Riverfront Property, Portland, Oregon. Includes a Qualitative Risk Assessment (Appendix E). January 9.

United States Department of Energy (USDOE). 2005. Final Comprehensive Risk Assessment (CRA) Work Plan and Methodology (Revision 1), Rocky Flats Environmental Technology Site, Golden, Colorado. Prepared by NewFields. September.

United States Environmental Protection Agency (EPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/1987a. Volumes I & II.

U.S. Environmental Protection Agency (EPA). 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. USEPA 540-R-97-006. Environmental Response Team, Edison, NJ.

United States Environmental Protection Agency (EPA). 2003. Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs). Attachment 4-5, Eco-SSL Standard Operating Procedure (SOP) #6. Derivation of Wildlife Toxicity Reference Value (TRV). OSWER Directive 92857-55. November.

United States Environmental Protection Agency (EPA). 2005a. Ecological Soil Screening Levels for Lead, Interim Final. OSWER Directive 9285.7-70. March.

United States Environmental Protection Agency (EPA). 2005b. Ecological Soil Screening Levels for Arsenic, Interim Final. OSWER Directive 9285.7-62. March.

United States Environmental Protection Agency (EPA). 2005c. Ecological Soil Screening Levels for Chromium, Interim Final. OSWER Directive 9285.7-66. March.

United States Environmental Protection Agency (EPA). 2007. Attachment 4-1, Guidance for Developing Ecological Soil-Screening Levels (Eco-SSLs), OSWER Directive 9285.7-55 (issued November 2003, revised February 2005, revised April 2007).

United States Environmental Protection Agency (EPA). 2010. Draft ProUCL Version 4.1 User Guide. USEPA Office of Research and Development. USEPA/600/R-07/041. May.

United States Environmental Protection Agency (EPA). 2011. ProUCL software, version 4.1.01. Downloaded at http://www.epa.gov/osp/hstl/tsc/software.htm. July.

United States Environmental Protection Agency (EPA). (no date). Assessing Intermittent or Variable Exposures at Lead Sites. EPA-R-03-008, OSWER 9285.7-76.

Washington State Department of Ecology (WDOE). 2012. Table 749-3: Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-3.pdf. From: Table Terrestrial Ecological Evaluation (TEE) Process - The Site-Specific Evaluation. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/site-specific.htm. Toxics Cleanup Program, Model Toxics Control Act (MTCA) Cleanup Regulation. Accessed 6/19/2012.

WindWard, LLC. 2004. Portland Harbor RIFS - Technical Memorandum: Toxicity Reference Value Selection for the Portland Harbor Ecological Risk Assessment. Prepared for the Lower Willamette Group (LWG). April 28.

WindWard, LLC. 2011. Portland Harbor RI/FS, Appendix G. Baseline Ecological Risk Assessment. Draft Final. Prepare for the Lower Willamette Group. July 1.

# TABLES

# TABLE 2-1 Ecological Level II Screening Level Summary Table

Willamette Cove

| Constituents of Interest (COIs) | | | Background Levels[3] | Plants | | | Invertebrates | | | Birds | | | Mammals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CASNo | Analyte[1] | Analyte Group/Methods[2] | Default Background Soil Concs (mg/kg) | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] |
| 12674-11-2 | Aroclor 1016 | Aroclors | NA | NA | 40[f] | 40 | NA | NA | NA | 0.7 | 0.655 [f] | 0.655 | 100 | 0.371[f] | 0.371 |
| 11104-28-2 | Aroclor 1221 | Aroclors | NA | NA | 40[f] | 40 | NA | NA | NA | 0.7 | 0.655 [f] | 0.655 | 4 | 0.371[f] | 0.371 |
| 11141-16-5 | Aroclor 1232 | Aroclors | NA | NA | 40[f] | 40 | NA | NA | NA | 0.7 | 0.655 [f] | 0.655 | 4 | 0.371[f] | 0.371 |
| 53469-21-9 | Aroclor 1242 | Aroclors | NA | NA | 40[f] | 40 | NA | NA | NA | 1.5 | 0.655 [f] | 0.655 | 5 | 0.371[f] | 0.371 |
| 12672-29-6 | Aroclor 1248 | Aroclors | NA | NA | 40[f] | 40 | NA | NA | NA | 0.7 | 0.655 [f] | 0.655 | 4 | 0.371[f] | 0.371 |
| 11097-69-1 | Aroclor 1254 | Aroclors | NA | NA | 40[f] | 40 | NA | NA | NA | 0.7 | 0.655 [f] | 0.655 | 4 | 0.371[f] | 0.371 |
| 11096-82-5 | Aroclor 1260 | Aroclors | NA | NA | 40[f] | 40 | NA | NA | NA | 0.7 | 0.655 [f] | 0.655 | 4 | 0.371[f] | 0.371 |
| 37324-23-5 | Aroclor 1262 | Aroclors | NA | NA | 40[f] | 40 | NA | NA | NA | 0.7 | 0.655 [f] | 0.655 | 4 | 0.371[f] | 0.371 |
| 11100-14-4 | Aroclor 1268 | Aroclors | NA | NA | 40[f] | 40 | NA | NA | NA | 0.7 | 0.655 [f] | 0.655 | 4 | 0.371[f] | 0.371 |
| 12767-79-2 | Total Aroclors [c] | Aroclors | NA | 40 | 40[f] | 40 | NA | NA | NA | NA | 0.655 [f] | 0.655 | 4 | 0.371[f] | 0.371 |
| TOC | total organic carbon | Conventionals | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| TSO | total solids | Conventionals | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 67562-39-4 | 1,2,3,4,6,7,8-Heptachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.000603 [g] | 6.03E-04 | NA | 0.000064 [g] | 6.40E-05 |
| 35822-46-9 | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0061594 [g] | 6.16E-03 | NA | 0.0000654 [g] | 6.54E-05 |
| 55673-89-7 | 1,2,3,4,7,8,9-Heptachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.000603 [g] | 6.03E-04 | NA | 0.000064 [g] | 6.40E-05 |
| 70648-26-9 | 1,2,3,4,7,8-Hexachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0000361 [g] | 3.61E-05 | NA | 0.0000038 [g] | 3.80E-06 |
| 39227-28-6 | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0001672 [g] | 1.67E-04 | NA | 0.0000089 [g] | 8.90E-06 |
| 57117-44-9 | 1,2,3,6,7,8-Hexachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0000361 [g] | 3.61E-05 | NA | 0.0000038 [g] | 3.80E-06 |
| 57653-85-7 | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0003614 [g] | 3.61E-04 | NA | 0.0000038 [g] | 3.80E-06 |
| 72918-21-9 | 1,2,3,7,8,9-Hexachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0000713 [g] | 7.13E-05 | NA | 0.0000076 [g] | 7.60E-06 |
| 19408-74-3 | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0000361 [g] | 3.61E-05 | NA | 0.0000038 [g] | 3.80E-06 |
| 57117-41-6 | 1,2,3,7,8-Pentachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0002067 [g] | 2.07E-04 | NA | 0.0000735 [g] | 7.35E-05 |
| 40321-76-4 | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0000994 [g] | 9.94E-05 | NA | 0.0000109 [g] | 1.09E-05 |
| 60851-34-5 | 2,3,4,6,7,8-Hexachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0000361 [g] | 3.61E-05 | NA | 0.0000038 [g] | 3.80E-06 |
| 57117-31-4 | 2,3,4,7,8-Pentachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.000016 [g] | 1.60E-05 | NA | 0.0000057 [g] | 5.70E-06 |
| 51207-31-9 | 2,3,7,8-Tetrachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0000209 [g] | 2.09E-05 | NA | 0.0000223 [g] | 2.23E-05 |
| 1746-01-6 | 2,3,7,8-Tetrachlorodibenzo-p-dioxin | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | 0.000055 | 0.0000217 [g] | 2.17E-05 | 1.20E-04 | 0.0000023 [g] | 2.30E-06 |
| 3268-87-9 | Octachlorodibenzo-p-dioxin | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.1028565 [g] | 1.03E-01 | NA | 0.0036436 [g] | 3.64E-03 |
| 39001-02-0 | Octachlorodibenzofuran | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | NA | 0.0259421 [g] | 2.59E-02 | NA | 0.0009169 [g] | 9.17E-04 |
| TEQ_TOTAL.0 | Total TCDD toxicity equivalent | Dioxins_Furans | NA | NA | NA | NA | NA | NA | NA | 0.000055 | 0.0000217 [g] | 2.17E-05 | 1.20E-04 | 0.0000023 [g] | 2.30E-06 |
| 93-76-5 | 2,4,5-T | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 94-75-7 | 2,4-D | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 94-82-6 | 2,4-DB | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 75-99-0 | Dalapon | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1918-00-9 | Dicamba | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 120-36-5 | Dichloroprop | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 88-85-7 | Dinoseb | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 94-74-6 | MCPA | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 93-65-2 | MCPP | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 93-72-1 | Silvex | Herbicides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 56-55-3 | Benzo(a)anthracene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 50-32-8 | Benzo(a)pyrene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 205-99-2 | Benzo(b)fluoranthene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 191-24-2 | Benzo(g,h,i)perylene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 207-08-9 | Benzo(k)fluoranthene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 218-01-9 | Chrysene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 53-70-3 | Dibenz(a,h)anthracene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 206-44-0 | Fluoranthene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 129-00-0 | Pyrene | HPAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| HPAH | High-Molecular Weight PAHs (sum) [b] | HPAHs | NA | NA | NA | NA | NA | 18 [d] | 18 | NA | NA | NA | NA | 1.1 [d] | 1.1 |

## TABLE 2-1 Ecological Level II Screening Level Summary Table

Willamette Cove

| Constituents of Interest (COIs) | | | Background Levels[3] | Plants | | | Invertebrates | | | Birds | | | Mammals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CASNo | Analyte[1] | Analyte Group/Methods[2] | Default Background Soil Concs (mg/kg) | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] |
| 91-57-6 | 2-Methylnaphthalene | LPAHs | NA | 10 | NA | 10 | NA | NA | NA | NA | NA | NA | 3900 | NA | 3900 |
| 83-32-9 | Acenaphthene | LPAHs | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA | 3900 | NA | 3900 |
| 208-96-8 | Acenaphthylene | LPAHs | NA | 10 | NA | 10 | NA | NA | NA | NA | NA | NA | 3900 | NA | 3900 |
| 120-12-7 | Anthracene | LPAHs | NA | 10 | NA | 10 | NA | NA | NA | NA | NA | NA | 3900 | NA | 3900 |
| 86-73-7 | Fluorene | LPAHs | NA | 10 | NA | 10 | 30 | NA | 30 | NA | NA | NA | 3900 | NA | 3900 |
| 91-20-3 | Naphthalene | LPAHs | NA | 10 | NA | 10 | NA | NA | NA | NA | NA | NA | 3900 | NA | 3900 |
| 85-01-8 | Phenanthrene | LPAHs | NA | 10 | NA | 10 | NA | NA | NA | NA | NA | NA | 3900 | NA | 3900 |
| LPAH | Low-Molecular Weight PAHs (sum) [a] | LPAHs | NA | NA | NA | NA | NA | 29 [d] | 29 | NA | NA | NA | NA | 100 | 100 |
| 191-26-4 | Anthanthrene | PAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 132-64-9 | Dibenzofuran | PAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.002 | NA | 0.002 |
| 90-12-0 | 1-Methylnaphthalene | PAHs | NA | 10 | NA | 10 | NA | NA | NA | NA | NA | NA | 3900 | NA | 3900 |
| BKBFLANTH | Benzo(b+k)fluoranthene | PAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 192-97-2 | Benzo(e)pyrene | PAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 130498-29-2 | Total PAHs | PAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| BAPEQ | Total BaPEq | PAHs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 125 | NA | 125 |
| 7429-90-5 | Aluminum | Metals | 52300 | 50 | NA | 50 | 600 | NA | 600 | 450 | NA | 450 | 107 | NA | 107 |
| 7440-36-0 | Antimony | Metals | 0.56 | 5 | NA | 5 | NA | 78 [d] | 78 | NA | NA | NA | 15 | 0.27 [d] | 0.27 |
| 7440-38-2 | Arsenic | Metals | 8.8 | 10 | 18 [d] | 18 | 60 | NA | 60 | 10 | 43 [d] | 43 | 29 | 46 [d] | 46 |
| 7440-39-3 | Barium | Metals | 790 | 500 | NA | 500 | 3000 | 330 [d] | 330 | 85 | NA | 85 | 638 | 2000 [d] | 2000 |
| 7440-41-7 | Beryllium | Metals | 2 | 10 | NA | 10 | NA | 40 [d] | 40 | NA | NA | NA | 83 | 21 [d] | 21 |
| 7440-43-9 | Cadmium | Metals | 0.63 | 4 | 32 [d] | 32 | 20 | 140 [d] | 140 | 6 | 0.77 [d] | 0.77 | 125 | 0.36 [d] | 0.36 |
| 7440-70-2 | Calcium | Metals | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 7440-47-3 | Chromium | Metals | 76 | 1 | NA | 1 | 0.4 | NA | 0.4 | 4 | 26 [d] | 26 | 340000 | 34 [d] | 34 |
| 7440-48-4 | Cobalt | Metals | NA | 20 | 13 [d] | 13 | 1000 | NA | 1000 | NA | 120 [d] | 120 | 150 | 230 [d] | 230 |
| 7440-50-8 | Copper | Metals | 34 | 100 | 70 [d] | 70 | 50 | 80 [d] | 80 | 190 | 28 [d] | 28 | 390 | 49 [d] | 49 |
| 7439-89-6 | Iron | Metals | 36100 | 10 | NA | 10 | 200 | NA | 200 | NA | NA | NA | NA | NA | NA |
| 7439-92-1 | Lead | Metals | 79 | 50 | 120 [d] | 120 | 500 | 1700 [d] | 1700 | 16 | 11 [d] | 11 | 4000 | 56 [d] | 56 |
| 7439-95-4 | Magnesium | Metals | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 7439-96-5 | Manganese | Metals | 1800 | 500 | 220 [d] | 220 | 100 | 450 [d] | 450 | 4125 | 4300 [d] | 4300 | 11000 | 4000 [d] | 4000 |
| 7439-97-6 | Mercury [d] | Metals | 0.23 | 0.3 | NA | 0.3 | 0.1 | NA | 0.1 | 1.5 | NA | 1.5 | 73 | NA | 73 |
| 7440-02-0 | Nickel | Metals | 47 | 30 | 38 [d] | 38 | 200 | 280 [d] | 280 | 320 | 210 [d] | 210 | 625 | 130 [d] | 130 |
| 7440-09-7 | Potassium | Metals | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 7782-49-2 | Selenium | Metals | 0.71 | 1 | 0.52 [d] | 0.52 | 70 | 4.1 [d] | 4.1 | 2 | 1.2 [d] | 1.2 | 25 | 0.63 [d] | 0.63 |
| 7440-22-4 | Silver | Metals | 0.82 | 2 | 560 [d] | 560 | 50 | NA | 50 | NA | 4.2 [d] | 4.2 | NA | 14 [d] | 14 |
| 7440-23-5 | Sodium | Metals | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 7440-28-0 | Thallium | Metals | 5.2 | 1 | NA | 1 | NA | NA | NA | NA | NA | NA | 1 | NA | NA |
| 7440-62-2 | Vanadium | Metals | 180 | 2 | NA | 2 | NA | NA | NA | 47 | 7.8 [d] | 7.8 | 25 | 280 [d] | 280 |
| 7440-66-6 | Zinc | Metals | 180 | 50 | 160 [d] | 160 | 200 | 120 [d] | 120 | 60 | 46 [d] | 46 | 20000 | 79 [d] | 79 |
| 53-19-0 | 2,4'-DDD | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.01 | NA | 0.01 | 100 | NA | 100 |
| 3424-82-6 | 2,4'-DDE | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.01 | NA | 0.01 | 100 | NA | 100 |
| 789-02-6 | 2,4'-DDT | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.01 | 0.093 | 0.093 | 100 | 0.021 | 0.021 |
| 72-54-8 | 4,4'-DDD | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.01 | NA | 0.01 | 100 | NA | 100 |
| 72-55-9 | 4,4'-DDE | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.01 | NA | 0.01 | 100 | NA | 100 |
| 50-29-3 | 4,4'-DDT | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.01 | 0.093 | 0.093 | 100 | 0.021 | 0.021 |
| 309-00-2 | Aldrin | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 25 | NA | 25 |
| 959-98-8 | alpha-Endosulfan | Pesticides | NA | NA | NA | NA | NA | NA | NA | 42 | NA | 42 | 20 | NA | 20 |
| 319-84-6 | alpha-Hexachlorocyclohexane | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 33213-65-9 | beta-Endosulfan | Pesticides | NA | NA | NA | NA | NA | NA | NA | 42 | NA | 42 | 20 | NA | 20 |
| 319-85-7 | beta-Hexachlorocyclohexane | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 12789-03-6 | Chlordane (technical) | Pesticides | NA | NA | NA | NA | NA | NA | NA | 9 | NA | 9 | 250 | NA | 250 |

## TABLE 2-1 Ecological Level II Screening Level Summary Table

Willamette Cove

| Constituents of Interest (COIs) | | | Background Levels[3] | Plants | | | Invertebrates | | | Birds | | | Mammals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CASNo | Analyte[1] | Analyte Group/Methods[2] | Default Background Soil Concs (mg/kg) | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] |
| 5103-71-9 | cis-Chlordane | Pesticides | NA | NA | NA | NA | NA | NA | NA | 9 | NA | 9 | 250 | NA | 250 |
| 5103-73-1 | cis-Nonachlor | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 319-86-8 | delta-Hexachlorocyclohexane | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 60-57-1 | Dieldrin | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.3 | 0.022 | 0.022 | 3 | 0.0049 | 0.0049 |
| 1031-07-8 | Endosulfan sulfate | Pesticides | NA | NA | NA | NA | NA | NA | NA | 42 | NA | 42 | 20 | NA | 20 |
| 72-20-8 | Endrin | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.04 | NA | 0.04 | 5 | NA | 5 |
| 7421-93-4 | Endrin aldehyde | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.04 | NA | 0.04 | 5 | NA | 5 |
| 53494-70-5 | Endrin ketone | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.04 | NA | 0.04 | 5 | NA | 5 |
| 50-00-0 | Formaldehyde | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 3900 | NA | 3900 |
| 5566-34-7 | gamma-Chlordane | Pesticides | NA | NA | NA | NA | NA | NA | NA | 9 | NA | 9 | 250 | NA | 250 |
| 58-89-9 | gamma-Hexachlorocyclohexane | Pesticides | NA | NA | NA | NA | NA | NA | NA | 8 | NA | 8 | 1000 | NA | 1000 |
| 76-44-8 | Heptachlor | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 15 | NA | 15 |
| 1024-57-3 | Heptachlor epoxide | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 72-43-5 | Methoxychlor | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 500 | NA | 500 |
| 2385-85-5 | Mirex | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 27304-13-8 | Oxychlordane | Pesticides | NA | NA | NA | NA | NA | NA | NA | 9 | NA | 9 | 250 | NA | 250 |
| TOTCHLDANE | Total Chlordanes | Pesticides | NA | NA | NA | NA | NA | NA | NA | 9 | NA | 9 | 250 | NA | 250 |
| TOTENDOSLFN | Total Endosulfan | Pesticides | NA | NA | NA | NA | NA | NA | NA | 42 | NA | 42 | 20 | NA | 20 |
| E966176 | Total of 2,4' and 4,4'-DDD, -DDE, -DDT | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.01 | 0.093 | 0.093 | 100 | 0.021 | 0.021 |
| PP_DDT3ISO | Total of 4,4'-DDD, -DDE, -DDT | Pesticides | NA | NA | NA | NA | NA | NA | NA | 0.01 | 0.093 | 0.093 | 100 | 0.021 | 0.021 |
| 8001-35-2 | Toxaphene | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 1000 | NA | 1000 |
| 5103-74-2 | trans-Chlordane | Pesticides | NA | NA | NA | NA | NA | NA | NA | 9 | NA | 9 | 250 | NA | 250 |
| 39765-80-5 | trans-Nonachlor | Pesticides | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| DRH | Diesel Range Hydrocarbons | Petroleum | NA | NA | NA | NA | NA | 200 [e] | 200 | NA | 6000 [e] | 6000 | NA | 6000 [e] | 6000 |
| DRH (SGT) | Diesel Range Hydrocarbons (silica gel treated) | Petroleum | NA | NA | NA | NA | NA | 200 [e] | 200 | NA | 6000 [e] | 6000 | NA | 6000 [e] | 6000 |
| GRH | Gasoline Range Hydrocarbons | Petroleum | NA | NA | NA | NA | NA | 100 [e] | 100 | NA | 5000 [e] | 5000 | NA | 5000 [e] | 5000 |
| M09800000 | Motor oil | Petroleum | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| M09800000 (SGT) | Motor oil (silica gel treated) | Petroleum | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| ORH | Oil Range Hydrocarbons | Petroleum | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| TPH | Total Petroleum Hydrocarbons | Petroleum | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4901-51-3 | 2,3,4,5-Tetrachlorophenol | Phenols | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 25167-83-3_3 | 2,3,4,6;2,3,5,6-Tetrachlorophenol coelution | Phenols | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 58-90-2 | 2,3,4,6-Tetrachlorophenol | Phenols | NA | NA | NA | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA |
| 935-95-5 | 2,3,5,6-Tetrachlorophenol | Phenols | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 95-95-4 | 2,4,5-Trichlorophenol | Phenols | NA | 4 | NA | 4 | 9 | NA | 9 | NA | NA | NA | NA | NA | NA |
| 88-06-2 | 2,4,6-Trichlorophenol | Phenols | NA | 10 | NA | 10 | 10 | NA | 10 | NA | NA | NA | NA | NA | NA |
| 120-83-2 | 2,4-Dichlorophenol | Phenols | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 105-67-9 | 2,4-Dimethylphenol | Phenols | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 51-28-5 | 2,4-Dinitrophenol | Phenols | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 87-65-0 | 2,6-Dichlorophenol | Phenols | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 95-57-8 | 2-Chlorophenol | Phenols | NA | 60 | NA | 60 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 95-48-7 | 2-Methylphenol | Phenols | NA | 50 | NA | 50 | NA | NA | NA | NA | NA | NA | 16000 | NA | 16000 |
| 88-75-5 | 2-Nitrophenol | Phenols | NA | 10 | NA | 10 | 7 | NA | 7 | NA | NA | NA | NA | NA | NA |
| C_3+4MPHN | 3- and 4-Methylphenol Coelution | Phenols | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | Phenols | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 59-50-7 | 4-Chloro-3-methylphenol | Phenols | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 106-44-5 | 4-Methylphenol | Phenols | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 100-02-7 | 4-Nitrophenol | Phenols | NA | 10 | NA | 10 | 7 | NA | 7 | NA | NA | NA | NA | NA | NA |
| 1319-77-3 | Cresol | Phenols | NA | 50 | NA | 50 | NA | NA | NA | NA | NA | NA | 16000 | NA | 16000 |
| 87-86-5 | Pentachlorophenol | Phenols | NA | 3 | 5 | 5 | 4 | 31 | 31 | NA | 2.1 | 2.1 | 30 | 2.8 | 2.8 |
| 108-95-2 | Phenol | Phenols | NA | 70 | NA | 70 | 30 | NA | 30 | NA | NA | NA | NA | NA | NA |
| 25167-83-3 | Tetrachlorophenol | Phenols | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 117-81-7 | Bis(2-ethylhexyl) Phthalate | Phthalates | NA | NA | NA | NA | NA | NA | NA | 4.5 | NA | 4.5 | 1020 | 0.925 [h] | 0.925 |

# TABLE 2-1 Ecological Level II Screening Level Summary Table

Willamette Cove

| Constituents of Interest (COIs) | | | Background Levels[3] | Plants | | | Invertebrates | | | Birds | | | Mammals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CASNo | Analyte[1] | Analyte Group/Methods[2] | Default Background Soil Concs (mg/kg) | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] |
| 85-68-7 | Butyl Benzyl Phthalate | Phthalates | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.239 [h] | 0.239 |
| 84-66-2 | Diethyl Phthalate | Phthalates | NA | 100 | NA | 100 | NA | NA | NA | NA | NA | NA | 250000 | 24.8 [h] | 24.8 |
| 131-11-3 | Dimethyl Phthalate | Phthalates | NA | NA | NA | NA | 200 | NA | 200 | NA | NA | NA | NA | 734 [h] | 734 |
| 84-74-2 | Di-n-butyl Phthalate | Phthalates | NA | 200 | NA | 200 | NA | NA | NA | 0.45 | NA | 0.45 | 30000 | 0.15 [h] | 0.15 |
| 117-84-0 | Di-n-octyl Phthalate | Phthalates | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 120-82-1 | 1,2,4-Trichlorobenzene | SVOCs | NA | NA | NA | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA |
| 95-50-1 | 1,2-Dichlorobenzene | SVOCs | NA | NA | NA | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA |
| 541-73-1 | 1,3-Dichlorobenzene | SVOCs | NA | NA | NA | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA |
| 106-46-7 | 1,4-Dichlorobenzene | SVOCs | NA | NA | NA | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA |
| 121-14-2 | 2,4-Dinitrotoluene | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 606-20-2 | 2,6-Dinitrotoluene | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 91-58-7 | 2-Chloronaphthalene | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 88-74-4 | 2-Nitroaniline | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 91-94-1 | 3,3'-Dichlorobenzidine | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 99-09-2 | 3-Nitroaniline | SVOCs | NA | 70 | NA | 70 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 101-55-3 | 4-Bromophenyl phenyl ether | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 106-47-8 | 4-Chloroaniline | SVOCs | NA | 40 | NA | 40 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 7005-72-3 | 4-Chlorophenyl phenyl ether | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 100-01-6 | 4-Nitroaniline | SVOCs | NA | 40 | NA | 40 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 62-53-3 | Aniline | SVOCs | NA | 200 | NA | 200 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 103-33-3 | Azobenzene | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 65-85-0 | Benzoic acid | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 100-51-6 | Benzyl alcohol | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 108-60-1 | Bis(2-chloro-1-methylethyl) ether | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 111-91-1 | Bis(2-chloroethoxy) methane | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 111-44-4 | Bis(2-chloroethyl) ether | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 39638-32-9 | Bis(2-chloroisopropyl) ether | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 86-74-8 | Carbazole | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 118-74-1 | Hexachlorobenzene | SVOCs | NA | NA | NA | NA | 1000 | NA | 1000 | NA | NA | NA | NA | NA | NA |
| 87-68-3 | Hexachlorobutadiene | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 77-47-4 | Hexachlorocyclopentadiene | SVOCs | NA | 10 | NA | 10 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 67-72-1 | Hexachloroethane | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 78-59-1 | Isophorone | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 98-95-3 | Nitrobenzene | SVOCs | NA | 8 | NA | 8 | 40 | NA | 40 | NA | NA | NA | NA | NA | NA |
| 62-75-9 | N-Nitrosodimethylamine | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 86-30-6 | N-Nitrosodiphenylamine | SVOCs | NA | NA | NA | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA |
| 621-64-7 | N-Nitrosodipropylamine | SVOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 630-20-6 | 1,1,1,2-Tetrachloroethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 71-55-6 | 1,1,1-Trichloroethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 55550 | NA | 55550 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 79-00-5 | 1,1,2-Trichloroethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 75-34-3 | 1,1-Dichloroethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 3750 | NA | 3750 |
| 75-35-4 | 1,1-Dichloroethene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 3750 | NA | 3750 |
| 563-58-6 | 1,1-Dichloropropene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 87-61-6 | 1,2,3-Trichlorobenzene | VOCs | NA | NA | NA | NA | 20 | NA | 20 | NA | NA | NA | NA | NA | NA |
| 96-18-4 | 1,2,3-Trichloropropane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 95-63-6 | 1,2,4-Trimethylbenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 107-06-2 | 1,2-Dichloroethane | VOCs | NA | NA | NA | NA | NA | NA | NA | 70 | NA | 70 | 2780 | NA | 2780 |
| 78-87-5 | 1,2-Dichloropropane | VOCs | NA | NA | NA | NA | 700 | NA | 700 | NA | NA | NA | NA | NA | NA |
| 108-67-8 | 1,3,5-Trimethylbenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 142-28-9 | 1,3-Dichloropropane | VOCs | NA | NA | NA | NA | 700 | NA | 700 | NA | NA | NA | NA | NA | NA |
| 99-87-6 | 1-Methyl-4-isopropylbenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

## TABLE 2-1 Ecological Level II Screening Level Summary Table
Willamette Cove

| Constituents of Interest (COIs) | | | Background Levels[3] | Plants | | | Invertebrates | | | Birds | | | Mammals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CASNo | Analyte[1] | Analyte Group/Methods[2] | Default Background Soil Concs (mg/kg) | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] |
| 594-20-7 | 2,2-Dichloropropane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 95-49-8 | 2-Chlorotoluene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 106-43-4 | 4-Chlorotoluene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 67-64-1 | Acetone | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 1250 | NA | 1250 |
| 71-43-2 | Benzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 3300 | NA | 3300 |
| 108-86-1 | Bromobenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 74-97-5 | Bromochloromethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 75-27-4 | Bromodichloromethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 75-25-2 | Bromoform | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 74-83-9 | Bromomethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 75-15-0 | Carbon disulfide | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 56-23-5 | Carbon tetrachloride | VOCs | NA | NA | NA | NA | 1000 | NA | 1000 | NA | NA | NA | 2000 | NA | 2000 |
| 108-90-7 | Chlorobenzene | VOCs | NA | NA | NA | NA | 40 | NA | 40 | NA | NA | NA | NA | NA | NA |
| 124-48-1 | Chlorodibromomethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 75-00-3 | Chloroethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 67-66-3 | Chloroform | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 1875 | NA | 1875 |
| 74-87-3 | Chloromethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 156-59-2 | cis-1,2-Dichloroethene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 2500 | NA | 2500 |
| 10061-01-5 | cis-1,3-Dichloropropene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 75-71-8 | Dichlorodifluoromethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 100-41-4 | Ethylbenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 106-93-4 | Ethylene dibromide | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 98-82-8 | Isopropylbenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 179601-23-1 | m,p-Xylene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 108-10-1 | Methyl isobutyl ketone | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 591-78-6 | Methyl n-butyl ketone | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1634-04-4 | Methyl tert-butyl ether | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 74-95-3 | Methylene bromide | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 75-09-2 | Methylene chloride | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 730 | NA | 730 |
| 78-93-3 | Methylethyl ketone | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 200000 | NA | 200000 |
| 104-51-8 | n-Butylbenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 103-65-1 | n-Propylbenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 95-47-6 | o-Xylene | VOCs | NA | 1 | NA | 1 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 135-98-8 | Sec-butylbenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 100-42-5 | Styrene | VOCs | NA | 300 | NA | 300 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 98-06-6 | tert-Butylbenzene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 127-18-4 | Tetrachloroethene | VOCs | NA | 10 | NA | 10 | NA | NA | NA | NA | NA | NA | 80 | NA | 80 |
| 108-88-3 | Toluene | VOCs | NA | 200 | NA | 200 | NA | NA | NA | NA | NA | NA | 1440 | NA | 1440 |
| 156-60-5 | trans-1,2-Dichloroethene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 2500 | NA | 2500 |
| 10061-02-6 | trans-1,3-Dichloropropene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 79-01-6 | Trichloroethene | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 40 | NA | 40 |
| 75-69-4 | Trichlorofluoromethane | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 75-01-4 | Vinyl chloride | VOCs | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 20 | NA | 20 |
| 1330-20-7 | Xylene | VOCs | NA | 100 | NA | 100 | NA | NA | NA | NA | NA | NA | 120 | NA | 120 |
| TEQ_PCB.0 | Dioxin-like PCB congener TCDD toxicity equivalent (ND = 0) | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 32598-13-3 | PCB077 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 70362-50-4 | PCB081 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 32598-14-4 | PCB105 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| PCB106_118 | PCB106 & 118 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 74472-37-0 | PCB114 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 65510-44-3 | PCB123 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 57465-28-8 | PCB126 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 38380-08-4 | PCB156 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

# TABLE 2-1 Ecological Level II Screening Level Summary Table

Willamette Cove

| Constituents of Interest (COIs) | | | Background Levels[3] | Plants | | | Invertebrates | | | Birds | | | Mammals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CASNo | Analyte[1] | Analyte Group/Methods[2] | Default Background Soil Concs (mg/kg) | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] | Oregon DEQ Level II SLVs[4] (mg/kg) | Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg) | Oregon DEQ-Approved Level II SLVs[6] |
| 69782-90-7 | PCB157 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 52663-72-6 | PCB167 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 32774-16-6 | PCB169 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 39635-31-9 | PCB189 | PCB_Congeners | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

Notes :

1 - Notes about summed analytes:

a - Sum of Low Molecular Weight PAHs (LPAHs): Sum of the detected LPAHs or the highest detection limit when not detected. LPAHs have three or fewer aromatic rings and include: 2-Methylnaphthalene, Acenaphthene, Acenaphthylene, Anthracene, Fluorene, Naphthalene, Phenanthrene. 1-Methylnaphthalene was not included in the sum.

b - Sum of High Molecular Weight PAHs (HPAHs): Sum of the detected HPAHs or the highest detection limit when not detected. HPAHs have four or more aromatic rings and include: Anthanthrene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(e)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Pyrene. Dibenzofuran was not included in the sum.

c- Total Aroclors: Sum of the detected Aroclors or the highest detection limit when not detected.

2 - Notes about analyte types/methods:

Metals analysis by U.S. Environmental Protection Agency (EPA) 6000/7000 Series Methods

Polynuclear Aromatic Hydrocarbons (PAHs) by U.S. Environmental Protection Agency (EPA) Method 8270 C SIM

Phthalates by U.S. Environmental Protection Agency (EPA) Method 8270C

Polychlorinated Biphenyl (PCB) Aroclors by U.S. Environmental Protection Agency (EPA) Method 8082

3 - Background levels: Upper Prediction Limit values for Portland Basin from Table 4 in Oregon DEQ. 2013. "Development of Oregon Background Metals Concentrations in Soil". March 2013. Except for Aluminum and Iron values, from San Juan, C. 1994. Natural Background Soil Metals Concentrations in Washington. Washington State Department of Ecology, Toxics Cleanup Program, Publication #94-115. October 1994. Updates at http://www.ecy.wa.gov/pubs/94115.pdf.

4 - Oregon DEQ Level II Screening Level Values (SLV) from Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final April 1998, updated May 2001.

chromium III SLV applied to chromium

arsenic III SLV applied to arsenic

Aroclor 1254 SLV applied to Aroclors without criteria

naphthalene SLV applied to LPAHs without criteria

o-cresol SLV applied to cresol

benzo(a)pyrene SLV applied to HPAHs without criteria

DDT EcoSSL applied to all compounds of DDT, DDE, DDD

endrin SLV applied to endrin aldehyde and endrin ketone

endosulfan SLV applied to alpha-endosulfan, beta-endosulfan, endosulfan sulfate, and total endosulfan

mercury (elemental, total) SLV applied to mercury

Chlordane SLV applied to cis-Chlordane, gamma-Chlordane oxychlordane, trans-chlordane, and total chlordane

1,4 dichlorobenzene SLV applied to 1,2 and 1,3 dichlorobenzene

1,2 dichloropropane SLV applied to 1,3 dichloropropane

1,1 dichloroethene SLV applied to 1,1 dichloroethane

2,4 dichlorophenol SLV applied to 2,6 dichlorophenol

4 nitrophenol SLV applied to 2 nitrophenol

5 -Screening values are consistent with recent Upland risk assessments (SIUFOU2 Level II ERA; Formation September, 2012)

d- Oregon DEQ requested that for metals and PAHs, USEPA Ecological Soil Screening Levels (EcoSSLs) should be used instead of DEQ SLVs. Eco SSLs were applied to all chemicals where values were available. Source: U.S. Environmental Protection Agency (USEPA). 2005. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). USEPA Office of Solid Waste and Emergency Response (OSWER), OSWER Directive 9285.7-55. Published November 2003, Revised November 2005 and subsequent contaminant-specific EcoSSL documents.

e - Oregon DEQ requested the use of TPH values available from Washington Department of Ecology Model Toxics Control Act (MTCA). Source: Washington State Department of Ecology (WDOE). 2012. Table 749-3: Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals. Available at: https://fortress.wa.gov/ecy/clarc/FocusSheets/Tee Site Specific.pdf . From: Table Terrestrial Ecological Evaluation (TEE) Process - The Site-Specific Evaluation. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/TEEHome.htm Toxics Cleanup Program, Model Toxics Control Act Cleanup (MTCA) Regulation. Accessed 6/19/2012. Values for "wildlife" were applied to both birds and mammals.

f - Oregon DEQ requested that for PCBs, the ERA should evaluate a bioaccumulation screening level value, which is available from Oak Ridge National Laboratory (ORNL) or Washington Department of Ecology (WDOE) Model Toxics Control Act (MTCA).

g - Oregon DEQ requested conenger specific RBCs using intake equations form EPA Eco SSLs (2007) and the prey uptake model from Jager (1998) [log Kww = 0.87 * log Kow - 2.0] and TRVs for shrew 1.00E-05 mg/kg/day and robin 1.40E-04 mg/kg/day in the June 19, 2013 response to comments. The RBC values used for the dioxin/Furan conengers were taken from the Mammalian and Avian Soil RBCs table that DEQ provided.

ORNL source: Efroymson, R.A., Suter, G.W.II, Sample, B.E., and Jones, D.S. 1997. 1997. Table 4: Preliminary Remediation Goals for Soils, in Preliminary Remediation Goals for Ecological Endpoints. Prepared for the U.S. Department of Energy, Ofice of Environmental Management. Available at http://www.clu-in.org/download/contaminantfocus/dnapl/Toxicology/doe_prg_tm162r2.pdf. August 1997. Value for total aroclors is based on exposures to shrews (and the document indicates "toxic concentration benchmarks are not available for earthworms. Therefore, the PRG cannot be assumed to protect earthworms."), and so the value was applied to mammals only.

WDOE source: Washington State Department of Ecology (WDOE). 2012. Table 749-3: Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-3.pdf. From: Table Terrestrial Ecological Evaluation (TEE) Process - The Site-Specific Evaluation. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/site-specific.htm. Toxics Cleanup Program, Model Toxics Control Act (MTCA) Cleanup Regulation. Accessed 6/19/2012. Values for "wildlife" were applied to both birds and mammals.

h - Oregon DEQ requested that for phthalates, EPA Region 5 provides additional SLVs for soil. Source: U.S. Environmental Protection Agency (USEPA). 2003. Region 5 RCRA Corrective Action, Ecological Screening Levels. Available at http://www.epa.gov/Region5/waste/cars/esl.htm. August 2003. The ESLs represent a protective benchmark (e.g., chronic no adverse effect levels); soil ecological screening levels are based on exposure to the Masked Shrew (Sorex cinerus). In this assessment, criteria are applied to mammals only.

6 - The final Oregon DEQ-approved Level II Screening Level Value (SLV) to be used in the risk evaluation is the Oregon DEQ-requested alternative value (footnote 5) where available, then the Oregon DEQ SLVs (Oregon DEQ 2001; footnote 4).

TABLE 2-2 Ecological Summary of Soil CPECs - West Parcel Upland Exposure Unit

| Receptor | Exceed Background? | # of Samples | # of ND | # of Detects | % ND | ProUCL? | Composite 90UCL[1] >Q=1 | Composite 90UCL[1] >Q=5 | Discrete 90UCL[1] >Q=1 | Discrete 90UCL[1] >Q=5 | CPEC?[2] | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plants** | | | | | | | | | | | | |
| Chromium | No | 4 | 0 | 4 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Mercury | Yes | 5 | 4 | 1 | 80 | N | -- | -- | -- | -- | Y (MDC) | > 15% ND; Only 1 detect |
| **Inverts** | | | | | | | | | | | | |
| Chromium | No | 4 | 0 | 4 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Mercury | Yes | 5 | 4 | 1 | 80 | N | -- | -- | -- | -- | Y (MDC) | > 15% ND; Only 1 detect |
| **Birds** | | | | | | | | | | | | |
| Lead | Yes | 5 | 0 | 5 | 0 | Y | No | No | Yes | Yes | N | 90UCL does not exceed background |
| Cadmium | Yes | 4 | 4 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| Dibutyl phthalate | NA | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| **Mammals** | | | | | | | | | | | | |
| Antimony | Yes | 3 | 3 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| Cadmium | Yes | 4 | 4 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| Bis (2-ethylhexyl) phthalate | NA | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| Dibutyl phthalate | NA | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| Butylbenzyl phthalate | NA | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| HPAHs | NA | 7 | 0 | 7 | 0 | Y | No | No | Yes | No | N | Does not exceed Q=5 |
| Dibenzofuran | NA | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |

Notes:

1 - Refer to Appendix D-1-5 for a description of all 90UCL calculations.

2 - Final CPECs are highlighted in gray

CPECs - Chemicals of Potential Ecological Concern    Q = 1 for T&E species

MDC - maximum detected concentration    Q = 5 for non-T&E species

90UCL - 90% upper confidence limit    T&E - listed threatened and endangered species

**TABLE 2-3 Ecological Summary of Soil CPECs - Central Parcel Upland Exposure Unit**

| Receptor | Exceed Background? | # of Samples | # of ND | # of Detects | % ND | ProUCL? | Composite 90UCL[1] >Q=1 | Composite 90UCL[1] >Q=5 | Discrete 90UCL[1] >Q=1 | Discrete 90UCL[1] >Q=5 | CPEC?[2] | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plants** | | | | | | | | | | | | |
| Antimony | Yes | 29 | 9 | 20 | 31 | N | -- | -- | -- | -- | Y (MDC) | > 15% ND |
| Chromium | Yes | 62 | 0 | 62 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Copper | Yes | 63 | 0 | 63 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Lead | Yes | 76 | 1 | 75 | 1 | N | -- | -- | -- | -- | Y (MDC) | |
| Mercury | Yes | 63 | 9 | 54 | 14 | N | -- | -- | -- | -- | Y (MDC) | |
| Zinc | Yes | 63 | 0 | 63 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| **Inverts** | | | | | | | | | | | | |
| Chromium | Yes | 62 | 0 | 62 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Copper | Yes | 63 | 0 | 63 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Diesel Range Hydrocarbons[3] | NA | 20 | 12 | 8 | 60 | N | -- | -- | -- | -- | Y (MDC) | > 15% ND |
| HPAH | NA | 46 | 2 | 44 | 4 | N | -- | -- | -- | -- | Y (MDC) | |
| Mercury | Yes | 63 | 9 | 54 | 14 | N | -- | -- | -- | -- | Y (MDC) | |
| Zinc | Yes | 63 | 0 | 63 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| **Birds** | | | | | | | | | | | | |
| Copper | Yes | 63 | 0 | 63 | 0 | Y | YES | YES | YES | YES | Y | |
| Total TCDD toxicity equivalent [4] | NA | 4 | 0 | 4 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Dibutyl phthalate | NA | 2 | 2 | 0 | 100 | N | -- | -- | -- | -- | N | No detected values |
| Lead | Yes | 76 | 1 | 75 | 1 | Y | YES | YES | YES | YES | Y | |
| Mercury | Yes | 63 | 9 | 54 | 14 | Y | YES | NO | YES | NO | N | Does not exceed Q=5 |
| Zinc | Yes | 63 | 0 | 63 | 0 | Y | YES | YES | YES | YES | Y | |
| **Mammals** | | | | | | | | | | | | |
| Antimony | Yes | 29 | 9 | 20 | 31 | Y | YES | YES | YES | YES | Y | > 15% ND |
| Bis(2-ethylhexyl) phthalate | NA | 2 | 2 | 0 | 100 | N | -- | -- | -- | -- | N | No detected values |
| Butylbenzyl phthalate | NA | 2 | 2 | 0 | 100 | N | -- | -- | -- | -- | N | No detected values |
| Cadmium | Yes | 40 | 17 | 23 | 43 | Y | YES | NO | YES | NO | N | Does not exceed; Q=5 > 15% ND; |
| Total TCDD toxicity equivalent [4] | NA | 4 | 0 | 4 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Dibutyl phthalate | NA | 2 | 2 | 0 | 100 | N | -- | -- | -- | -- | N | No detected values |
| Copper | Yes | 63 | 0 | 63 | 0 | Y | YES | YES | YES | YES | Y | |
| Lead | Yes | 76 | 1 | 75 | 1 | Y | YES | YES | YES | YES | Y | |
| Dibenzofuran | NA | 2 | 2 | 0 | 100 | N | -- | -- | -- | -- | N | No detected values |
| HPAH | NA | 46 | 2 | 44 | 4 | N | YES | YES | YES | YES | Y | |
| Zinc | Yes | 63 | 9 | 54 | 14 | Y | YES | YES | YES | YES | Y | |

Notes:

1 - Refer to Appendix D-2-5 for a description of all 90UCL calculations.

2 - Final CPECs are highlighted in gray

3. Diesel range hydrocarbons were not included in the exposure and risk calculations because no toxicity information is available for quantifying risk.
Diesel range hydrocarbons is a mixture of many organic and inorganic chemicals, many of which are included in the COI list and were included in the risk screen.

4 - Concentrations exceeded screening levels for one or more dioxin/furan congeners. See Appendix D, Table D-2-3.

CPECs - Chemicals of Potential Ecological Concern

MDC - maximum detected concentration

90UCL - 90% upper confidence limit

Q = 1 for T&E species

Q = 5 for non-T&E species

T&E - listed threatened and endangered species

**TABLE 2-4 Ecological Summary of Soil CPECs - East Parcel Upland Exposure Unit**

| Receptor | Exceed Background? | # of Samples | # of ND | # of Detects | % ND | ProUCL? | Composite 90UCL[1] >Q=1 | Composite 90UCL[1] >Q=5 | Discrete 90UCL[1] >Q=1 | Discrete 90UCL[1] >Q=5 | CPEC?[2] | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plants** | | | | | | | | | | | | |
| Antimony | Yes | 21 | 2 | 19 | 10 | N | -- | -- | -- | -- | Y (MDC) | |
| Chromium | Yes | 24 | 0 | 24 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Copper | Yes | 25 | 0 | 25 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Lead | Yes | 23 | 0 | 23 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Nickel | Yes | 22 | 0 | 22 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Zinc | Yes | 25 | 0 | 25 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| **Inverts** | | | | | | | -- | -- | -- | -- | | |
| Chromium | Yes | 24 | 0 | 24 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Copper | Yes | 25 | 0 | 25 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Diesel Range Hydrocarbons (silica gel treated)[3] | NA | 2 | 0 | 2 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Mercury | Yes | 23 | 5 | 18 | 22 | N | -- | -- | -- | -- | Y (MDC) | > 15% ND |
| Zinc | Yes | 25 | 0 | 25 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| **Birds** | | | | | | | | | | | | |
| Aroclor 1254 | NA | 23 | 20 | 3 | 87 | Y | -- | -- | NO | NO | N | > 15% ND;1 observation for composite |
| Aroclors | NA | 23 | 15 | 8 | 65 | Y | YES | YES | NO | NO | Y | > 15% ND; only for composite |
| Chromium | Yes | 24 | 0 | 24 | 0 | Y | YES | NO | YES | NO | N | Does not exceed Q=5 |
| Copper | Yes | 25 | 0 | 25 | 0 | Y | YES | YES | YES | YES | Y | |
| Dibutyl phthalate | Na | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| Lead | Yes | 23 | 0 | 23 | 0 | Y | YES | YES | YES | YES | Y | |
| Zinc | Yes | 25 | 0 | 25 | 0 | Y | YES | YES | YES | YES | Y | |
| **Mammals** | | | | | | | | | | | | |
| Antimony | Yes | 21 | 2 | 19 | 10 | Y | YES | YES | YES | YES | Y | |
| Aroclor 1254 | NA | 23 | 20 | 3 | 87 | Y | -- | -- | NO | NO | N | > 15% ND;1 observation for composite |
| Aroclors | NA | 23 | 15 | 8 | 65 | Y | YES | YES | YES | NO | Y | > 15% ND; only for composite |
| Bis(2-ethylhexyl) phthalate | NA | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| Butylbenzyl phthalate | NA | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| Copper | Yes | 25 | 0 | 25 | 0 | Y | YES | YES | YES | YES | Y | |
| Dibutyl phthalate | NA | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| Dibenzofuran | NA | 1 | 1 | 0 | 100 | N | -- | -- | -- | -- | N | No Detected Values |
| HPAHs | NA | 20 | 0 | 20 | 0 | Y | YES | NO | YES | NO | N | Does not exceed Q=5 |
| Lead | Yes | 23 | 0 | 23 | 0 | Y | YES | YES | YES | YES | Y | |
| Zinc | Yes | 25 | 0 | 25 | 0 | Y | YES | YES | YES | YES | Y | |

Notes:

1 - Refer to Appendix D-3-5 for a description of all 90UCL calculations.

2 - Final CPECs are highlighted in gray

3. Diesel range hydrocarbons were not included in the exposure and risk calculations because no toxicity information is available for quantifying risk.
Diesel range hydrocarbons is a mixture of many organic and inorganic chemicals, many of which are included in the COI list and were included in the risk screen.

CPECs - Chemicals of Potential Ecological Concern Q = 1 for T&E species

MDC - maximum detected concentration Q = 5 for non-T&E species

90UCL - 90% upper confidence limit T&E - listed threatened and endangered species

**TABLE 2-5 Ecological Summary of Soil CPECs - Inner Cove Beach Exposure Unit**

| Receptor | Exceed Background? | # of Samples | # of ND | # of Detects | % ND | ProUCL? | Composite 90UCL[1] >Q=1 | Composite 90UCL[1] >Q=5 | Discrete 90UCL[1] >Q=1 | Discrete 90UCL[1] >Q=5 | CPEC?[2] | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plants** | | | | | | | | | | | | |
| Aluminum | No | 4 | 0 | 4 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Antimony | Yes | 13 | 0 | 13 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Aroclors | NA | 9 | 5 | 4 | 56 | N | -- | -- | -- | -- | Y (MDC) | > 15% ND |
| Aroclor 1254 | NA | 9 | 5 | 4 | 56 | N | -- | -- | -- | -- | Y (MDC) | > 15% ND |
| Chromium | No | 13 | 0 | 13 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Copper | Yes | 13 | 0 | 13 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Iron | NA | 3 | 0 | 3 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Lead | Yes | 13 | 0 | 13 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Mercury | Yes | 13 | 5 | 8 | 38 | N | -- | -- | -- | -- | Y (MDC) | > 15% ND |
| Vanadium | No | 13 | 0 | 13 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| **Inverts** | | | | | | | | | | | | |
| Aluminum | NA | 4 | 0 | 4 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Chromium | No | 13 | 0 | 13 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Copper | Yes | 13 | 0 | 13 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Diesel Range Hydrocarbons[3] | NA | 11 | 1 | 10 | 9 | N | -- | -- | -- | -- | Y (MDC) | |
| Diesel Range Hydrocarbons[3] (silica gel treated) | NA | 5 | 0 | 5 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Iron | NA | 3 | 0 | 3 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Lead | Yes | 13 | 0 | 13 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Mercury | Yes | 13 | 5 | 8 | 38 | N | -- | -- | -- | -- | Y (MDC) | > 15% ND |
| Zinc | Yes | 12 | 0 | 12 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| **Birds** | | | | | | | | | | | | |
| Aluminum | No | 4 | 0 | 4 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Aroclor 1254 | NA | 9 | 5 | 4 | 56 | Y | -- | -- | Yes | Yes | Y | > 15% ND |
| Aroclors | NA | 9 | 5 | 4 | 56 | Y | -- | -- | Yes | Yes | Y | > 15% ND |
| Barium | NA | 3 | 0 | 3 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| Copper | Yes | 13 | 0 | 13 | 0 | Y | -- | -- | Yes | Yes | Y | |
| Diesel Range Hydrocarbons[3] | NA | 11 | 1 | 10 | 9 | Y | -- | -- | Yes | Yes | Y | |
| Lead | Yes | 13 | 0 | 13 | 0 | Y | -- | -- | Yes | Yes | Y | |
| Mercury | Yes | 13 | 5 | 8 | 38 | Y | -- | -- | Yes | Yes | Y | > 15% ND |
| Vanadium | No | 3 | 0 | 3 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Zinc | Yes | 12 | 0 | 12 | 0 | Y | -- | -- | Yes | Yes | Y | |
| **Mammals** | | | | | | | | | | | | |
| Aluminum | No | 4 | 0 | 4 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Antimony | Yes | 13 | 0 | 13 | 0 | Y | -- | -- | Yes | Yes | Y | |
| Aroclor 1254 | NA | 9 | 5 | 4 | 56 | Y | -- | -- | Yes | Yes | Y | > 15% ND |
| Aroclors | NA | 9 | 5 | 4 | 56 | Y | -- | -- | Yes | Yes | Y | > 15% ND |
| Copper | Yes | 13 | 0 | 13 | 0 | Y | -- | -- | Yes | Yes | Y | |
| Diesel Range Hydrocarbons[3] | NA | 11 | 1 | 10 | 9 | Y | -- | -- | Yes | Yes | Y | |
| Dibenzofuran | NA | 1 | 0 | 1 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| HPAH | NA | 9 | 3 | 6 | 33 | Y | -- | -- | Yes | Yes | Y | |

**TABLE 2-5 Ecological Summary of Soil CPECs - Inner Cove Beach Exposure Unit**

| Receptor | Exceed Background? | # of Samples | # of ND | # of Detects | % ND | ProUCL? | Composite 90UCL[1] >Q=1 | Composite 90UCL[1] >Q=5 | Discrete 90UCL[1] >Q=1 | Discrete 90UCL[1] >Q=5 | CPEC?[2] | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lead | Yes | 13 | 0 | 13 | 0 | Y | -- | -- | Yes | Yes | Y | |
| Zinc | Yes | 12 | 0 | 12 | 0 | Y | -- | -- | Yes | Yes | Y | |

Notes:

1 - Refer to Appendix D-4-5 for a description of all 90UCL calculations.

2 - Final CPECs are highlighted in gray

3. Diesel range hydrocarbons were not included in the exposure and risk calculations because no toxicity information is available for quantifying risk.
Diesel range hydrocarbons is a mixture of many organic and inorganic chemicals, many of which are included in the COI list and were included in the risk screen.

CPECs - Chemicals of Potential Ecological Concern

MDC - maximum detected concentration

90UCL - 90% upper confidence limit

Q = 1 for T&E species

Q = 5 for non-T&E species

T&E - listed threatened and endangered species

**TABLE 2-6 Ecological Summary of Soil CPECs - Central Beach Exposure Unit**

| Receptor | Exceed Background? | # of Samples | # of ND | # of Detects | % ND | ProUCL? | Composite 90UCL[1] >Q=1 | Composite 90UCL[1] >Q=5 | Discrete 90UCL[1] >Q=1 | Discrete 90UCL[1] >Q=5 | CPEC?[2] | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plants** | | | | | | | | | | | | |
| Aluminum | No | 2 | 0 | 2 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Chromium | No | 6 | 0 | 6 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| **Inverts** | | | | | | | | | | | | |
| Aluminum | No | 2 | 0 | 2 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Chromium | No | 6 | 0 | 6 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Mercury | Yes | 6 | 0 | 6 | 0 | N | -- | -- | -- | -- | Y (MDC) | |
| **Birds** | | | | | | | | | | | | |
| Aluminum | No | 2 | 0 | 2 | 0 | N | -- | -- | -- | -- | N | Does not exceed background |
| Cadmium | Yes | 6 | 3 | 3 | 50 | Y | -- | -- | -- | -- | Y (MDC) | > 15% ND; Only 2 observations for composite, only 4 obervations for discrete |
| Lead | No | 6 | 0 | 6 | 0 | Y | -- | -- | -- | -- | N | Does not exceed background. |
| **Mammals** | | | | | | | | | | | | |
| Aluminum | No | 2 | 0 | 2 | 0 | N | -- | -- | -- | -- | N | |
| Cadmium | Yes | 6 | 3 | 3 | 50 | Y | -- | -- | -- | -- | Y (MDC) | > 15% ND; Only 2 observations values for composite, only 4 observations values for discrete |
| HPAHs | NA | 9 | 2 | 7 | 22 | Y | YES | NO | -- | -- | N | Does not exceed Q=5 |

Notes:
1 - Refer to Appendix D-5-5 for a description of all 90UCL calculations.
2 - Final CPECs are highlighted in gray

CPECs - Chemicals of Potential Ecological Concern
MDC - maximum detected concentration
90UCL - 90% upper confidence limit
Q = 1 for T&E species
Q = 5 for non-T&E species
T&E - listed threatened and endangered species

TABLE 2-7 Ecological Summary of Soil CPECs - Wharf Road Exposure Unit (Dioxins Only)

| Receptor | Exceed Background? | # of Samples | # of ND | # of Detects | % ND | ProUCL? | Avg[1]>Q=1 | Avg[1]>Q=5 | CPEC?[2] | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| **Birds** | | | | | | | | | | |
| Total TCDD toxicity equivalent | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 2,3,4,7,8-Pentachlorodibenzofuran | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 2,3,4,6,7,8-Hexachlorodibenzofuran | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| **Mammals** | | | | | | | | | | |
| Total TCDD toxicity equivalent | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 2,3,4,7,8-Pentachlorodibenzofuran | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 1,2,3,6,7,8-Hexachlorodibenzofuran | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 2,3,4,6,7,8-Hexachlorodibenzofuran | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| 1,2,3,4,7,8-Hexachlorodibenzofuran | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |
| Octachlorodibenzofuran | NA | 3 | 0 | 3 | 0.00 | Avg | Yes | Yes | Y | |

Notes:

1 - Refer to Appendix D-6-1 for a description of average calculations.

2 - Final CPECs are highlighted in gray

Avg = average

CPECs - Chemicals of Potential Ecological Concern

MDC - maximum detected concentration

Q = 1 for T&E species

Q = 5 for non-T&E species

T&E - listed threatened and endangered species

## TABLE 2-8 Ecological Summary of CPECs - Detected Chemicals without Screening Levels

Willamette Cove

| CAS Number | Standard Analyte | Standard Analyte Group | Detection Frequency by Exposure Unit | | | | | | Oregon DEQ-Approved Level II SLVs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Central Beach Exposure Unit | Central Parcel Upland Exposure Unit | East Parcel Upland Exposure Unit | Inner Cove Beach Exposure Unit | West Parcel Upland Exposure Unit | Wharf Road Exposure Unit | PLANTS | INVERTS | BIRDS | MAMMALS |
| **CHEMICALS LACKING SLVS** | | | | | | | | | | | | |
| TOC | Total organic carbon | Conventionals | 100% | ns | 100% | 100% | ns | ns | NA | NA | NA | NA |
| TSO | Total solids | Conventionals | 100% | ns | ns | 100% | ns | ns | NA | NA | NA | NA |
| 7440-70-2 | Calcium | Metals | ns | ns | ns | 100% | ns | ns | NA | NA | NA | NA |
| 7439-95-4 | Magnesium | Metals | ns | ns | ns | 100% | ns | ns | NA | NA | NA | NA |
| 7440-09-7 | Potassium | Metals | ns | ns | ns | 100% | ns | ns | NA | NA | NA | NA |
| 7440-23-5 | Sodium | Metals | ns | ns | ns | 100% | ns | ns | NA | NA | NA | NA |
| 130498-29-2 | Total PAHs | PAHs | 78% | 96% | 100% | 75% | 100% | ns | NA | NA | NA | NA |
| TEQ_PCB.0 | Dioxin-like PCB congener TCDD toxicity equivalent | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 32598-13-3 | PCB077 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 70362-50-4 | PCB081 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 32598-14-4 | PCB105 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| PCB106_118 | PCB106 & 118 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 74472-37-0 | PCB114 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 65510-44-3 | PCB123 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 57465-28-8 | PCB126 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 38380-08-4 | PCB156 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 69782-90-7 | PCB157 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 52663-72-6 | PCB167 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 39635-31-9 | PCB189 | PCB_Congeners | 100% | ns | ns | ns | ns | ns | NA | NA | NA | NA |
| 319-85-7 | beta-Hexachlorocyclohexane | Pesticides | 50% | 0% | 0% | 0% | ns | ns | NA | NA | NA | NA |
| M09800000 | Motor oil | Petroleum | ns | 100% | ns | 100% | ns | ns | NA | NA | NA | NA |
| M09800000 (SGT) | Motor oil (silica gel treated) | Petroleum | ns | 100% | 100% | 100% | ns | ns | NA | NA | NA | NA |
| ORH | Oil Range Hydrocarbons | Petroleum | 0% | 74% | 57% | 100% | 58% | ns | NA | NA | NA | NA |
| TPH | Total Petroleum Hydrocarbons | Petroleum | ns | ns | ns | 100% | ns | ns | NA | NA | NA | NA |
| 86-74-8 | Carbazole | SVOCs | 50% | ns | 0% | 100% | ns | ns | NA | NA | NA | NA |
| 95-63-6 | 1,2,4-Trimethylbenzene | VOCs | ns | 0% | 40% | 100% | 0% | ns | NA | NA | NA | NA |
| 108-67-8 | 1,3,5-Trimethylbenzene | VOCs | ns | 0% | 0% | 40% | 0% | ns | NA | NA | NA | NA |
| 99-87-6 | 1-Methyl-4-isopropylbenzene | VOCs | ns | 0% | 40% | 60% | 0% | ns | NA | NA | NA | NA |
| 75-15-0 | Carbon disulfide | VOCs | ns | 0% | 0% | 40% | 0% | ns | NA | NA | NA | NA |
| 74-87-3 | Chloromethane | VOCs | ns | 0% | 40% | 40% | 0% | ns | NA | NA | NA | NA |
| 100-41-4 | Ethylbenzene | VOCs | ns | 0% | 40% | 80% | 0% | ns | NA | NA | NA | NA |
| 98-82-8 | Isopropylbenzene | VOCs | ns | 0% | 40% | 40% | 0% | ns | NA | NA | NA | NA |
| 179601-23-1 | m,p-Xylene | VOCs | ns | 0% | 40% | 100% | 0% | ns | NA | NA | NA | NA |
| 104-51-8 | n-Butylbenzene | VOCs | ns | 0% | 40% | 60% | 0% | ns | NA | NA | NA | NA |
| 103-65-1 | n-Propylbenzene | VOCs | ns | 0% | 40% | 80% | 0% | ns | NA | NA | NA | NA |
| 135-98-8 | Sec-butylbenzene | VOCs | ns | 0% | 40% | 60% | 0% | ns | NA | NA | NA | NA |
| **CHEMICALS WITH SLV FOR AT LEAST ONE RECEPTOR** | | | | | | | | | | | | |
| 11097-69-1 | Aroclor 1254 | Aroclors | 0% | 0% | 13% | 44% | 0% | ns | 40 | NA | 0.655 | 0.371 |
| 11096-82-5 | Aroclor 1260 | Aroclors | 0% | 10% | 30% | 0% | 33% | ns | 40 | NA | 0.655 | 0.371 |
| 12767-79-2 | Aroclors | Aroclors | 0% | 10% | 35% | 44% | 33% | ns | 40 | NA | 0.655 | 0.371 |
| 39001-02-0 | Octachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0259421 | 0.0009169 |
| 3268-87-9 | Octachlorodibenzo-p-dioxin | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.1028565 | 0.0036436 |
| 67562-39-4 | 1,2,3,4,6,7,8-Heptachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.000603 | 0.000064 |
| 35822-46-9 | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0061594 | 0.0000654 |
| 55673-89-7 | 1,2,3,4,7,8,9-Heptachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.000603 | 0.000064 |
| 70648-26-9 | 1,2,3,4,7,8-Hexachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0000361 | 0.0000038 |
| 39227-28-6 | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0001672 | 0.0000089 |
| 57117-44-9 | 1,2,3,6,7,8-Hexachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0000361 | 0.0000038 |
| 57653-85-7 | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0003614 | 0.0000038 |
| 72918-21-9 | 1,2,3,7,8,9-Hexachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 0% | NA | NA | 0.0000713 | 0.0000076 |
| 19408-74-3 | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0000361 | 0.0000038 |
| 57117-41-6 | 1,2,3,7,8-Pentachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0002067 | 0.0000735 |
| 40321-76-4 | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0000994 | 0.0000109 |

## TABLE 2-8 Ecological Summary of CPECs - Detected Chemicals without Screening Levels

Willamette Cove

| CAS Number | Standard Analyte | Standard Analyte Group | Detection Frequency by Exposure Unit | | | | | | Oregon DEQ-Approved Level II SLVs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Central Beach Exposure Unit | Central Parcel Upland Exposure Unit | East Parcel Upland Exposure Unit | Inner Cove Beach Exposure Unit | West Parcel Upland Exposure Unit | Wharf Road Exposure Unit | PLANTS | INVERTS | BIRDS | MAMMALS |
| 60851-34-5 | 2,3,4,6,7,8-Hexachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0000361 | 0.0000038 |
| 57117-31-4 | 2,3,4,7,8-Pentachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.000016 | 0.0000057 |
| 51207-31-9 | 2,3,7,8-Tetrachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0000209 | 0.0000223 |
| 1746-01-6 | 2,3,7,8-Tetrachlorodibenzo-p-dioxin | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0000217 | 0.0000023 |
| 39001-02-0 | Octachlorodibenzofuran | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.0259421 | 0.0009169 |
| 3268-87-9 | Octachlorodibenzo-p-dioxin | Dioxins_Furans | (a) | (a) | ns | (a) | ns | 100% | NA | NA | 0.1028565 | 0.0036436 |
| TEQ_DIOXIN.0 | Total TCDD toxicity equivalent | Dioxins_Furans | 100% | 100% | ns | 100% | ns | 100% | NA | NA | 0.0000217 | 0.0000023 |
| 7440-36-0 | Antimony | Metals | 67% | 69% | 90% | 100% | 0% | ns | 5 | 78 | NA | 0.27 |
| 7440-41-7 | Beryllium | Metals | 0% | 90% | 90% | 100% | 0% | ns | 10 | 40 | NA | 21 |
| 7439-89-6 | Iron | Metals | ns | ns | ns | 100% | ns | ns | 10 | 200 | NA | NA |
| 7440-28-0 | Thallium | Metals | 0% | 86% | 90% | 89% | 0% | ns | 1 | NA | NA | NA |
| 7440-62-2 | Vanadium | Metals | ns | ns | ns | 100% | ns | ns | 2 | NA | 7.8 | 280 |
| 90-12-0 | 1-Methylnaphthalene | PAHs | 0% | 69% | 82% | 100% | ns | ns | 10 | NA | NA | 3900 |
| 91-57-6 | 2-Methylnaphthalene | PAHs | 33% | 72% | 75% | 83% | 0% | ns | 10 | NA | NA | 3900 |
| 83-32-9 | Acenaphthene | PAHs | 11% | 24% | 45% | 56% | 0% | ns | 20 | NA | NA | 3900 |
| 208-96-8 | Acenaphthylene | PAHs | 33% | 65% | 60% | 56% | 29% | ns | 10 | NA | NA | 3900 |
| 120-12-7 | Anthracene | PAHs | 22% | 67% | 60% | 44% | 29% | ns | 10 | NA | NA | 3900 |
| 56-55-3 | Benzo(a)anthracene | PAHs | 78% | 91% | 75% | 67% | 86% | ns | NA | NA | NA | 125 |
| 50-32-8 | Benzo(a)pyrene | PAHs | 78% | 96% | 90% | 67% | 100% | ns | NA | NA | NA | 125 |
| 205-99-2 | Benzo(b)fluoranthene | PAHs | 78% | 96% | 94% | 67% | 100% | ns | NA | NA | NA | 125 |
| BKBFLANTH | Benzo(b+k)fluoranthene | PAHs | ns | 50% | 33% | ns | 0% | ns | NA | NA | NA | 125 |
| 192-97-2 | Benzo(e)pyrene | PAHs | ns | ns | 50% | ns | ns | ns | NA | NA | NA | 125 |
| 191-24-2 | Benzo(g,h,i)perylene | PAHs | 67% | 93% | 85% | 67% | 100% | ns | NA | NA | NA | 125 |
| 207-08-9 | Benzo(k)fluoranthene | PAHs | 78% | 89% | 89% | 67% | 100% | ns | NA | NA | NA | 125 |
| 218-01-9 | Chrysene | PAHs | 78% | 96% | 100% | 67% | 100% | ns | NA | NA | NA | 125 |
| 53-70-3 | Dibenzo(a,h)anthracene | PAHs | 33% | 80% | 60% | 56% | 86% | ns | NA | NA | NA | 125 |
| 206-44-0 | Fluoranthene | PAHs | 67% | 96% | 95% | 67% | 100% | ns | NA | NA | NA | 125 |
| 86-73-7 | Fluorene | PAHs | 22% | 28% | 45% | 56% | 0% | ns | 10 | 30 | NA | 3900 |
| HPAH | High Molecular Weight PAH | PAHs | 78% | 96% | 100% | 67% | 100% | ns | NA | 18 | NA | 1.1 |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | PAHs | 67% | 93% | 75% | 67% | 100% | ns | NA | NA | NA | 125 |
| LPAH | Low Molecular Weight PAH | PAHs | 44% | 89% | 85% | 67% | 86% | ns | NA | 29 | NA | 100 |
| 91-20-3 | Naphthalene | PAHs | 33% | 52% | 52% | 67% | 9% | ns | 10 | NA | NA | 3900 |
| 85-01-8 | Phenanthrene | PAHs | 44% | 87% | 80% | 67% | 86% | ns | 10 | NA | NA | 3900 |
| 129-00-0 | Pyrene | PAHs | 67% | 96% | 95% | 67% | 100% | ns | NA | NA | NA | 125 |
| BAPEQ | Total BaPEq | PAHs | 78% | 96% | 100% | 67% | 100% | ns | NA | NA | NA | 125 |
| 789-02-6 | 2,4'-DDT | Pesticides | 50% | ns | ns | 0% | ns | ns | NA | NA | 0.093 | 0.021 |
| 72-54-8 | 4,4'-DDD | Pesticides | 50% | 0% | 0% | 0% | ns | ns | NA | NA | 0.01 | 100 |
| 72-55-9 | 4,4'-DDE | Pesticides | 50% | 0% | 0% | 0% | ns | ns | NA | NA | 0.01 | 100 |
| 50-29-3 | 4,4'-DDT | Pesticides | 50% | 0% | 33% | 0% | ns | ns | NA | NA | 0.093 | 0.021 |
| 33213-65-9 | beta-Endosulfan | Pesticides | 50% | 0% | 0% | 0% | ns | ns | NA | NA | 42 | 20 |
| 72-20-8 | Endrin | Pesticides | 50% | 0% | 0% | 0% | ns | ns | NA | NA | 0.04 | 5 |
| TOTENDOSLFN | Total Endosulfan | Pesticides | 50% | ns | ns | 0% | ns | ns | NA | NA | 42 | 20 |
| E966176 | Total of 2,4' and 4,4'-DDD, -DDE, -DDT | Pesticides | 50% | ns | ns | 0% | ns | ns | NA | NA | 0.093 | 0.021 |
| PP_DDT3ISO | Total of 4,4'-DDD, -DDE, -DDT | Pesticides | 50% | 0% | 33% | 0% | ns | ns | NA | NA | 0.093 | 0.021 |
| DRH | Diesel Range Hydrocarbons | Petroleum | 0% | 40% | 21% | 91% | 0% | ns | NA | 200 | 6000 | 6000 |
| DRH (SGT) | Diesel Range Hydrocarbons (silica gel treated) | Petroleum | ns | 100% | 100% | 100% | ns | ns | NA | 200 | 6000 | 6000 |
| GRH | Gasoline Range Hydrocarbons | Petroleum | ns | 0% | ns | 50% | ns | ns | NA | 100 | 5000 | 5000 |
| 84-74-2 | Dibutyl phthalate | Phthalates | 100% | 0% | 0% | 100% | 0% | ns | 200 | NA | 0.45 | 0.15 |
| 120-82-1 | 1,2,4-Trichlorobenzene | SVOCs | 0% | 0% | 0% | 33% | 0% | ns | NA | 20 | NA | NA |
| 95-50-1 | 1,2-Dichlorobenzene | SVOCs | 0% | 0% | 0% | 17% | 0% | ns | NA | 20 | NA | NA |
| 541-73-1 | 1,3-Dichlorobenzene | SVOCs | 0% | 0% | 33% | 50% | 0% | ns | NA | 20 | NA | NA |
| 106-46-7 | 1,4-Dichlorobenzene | SVOCs | 0% | 0% | 33% | 67% | 0% | ns | NA | 20 | NA | NA |
| 132-64-9 | Dibenzofuran | SVOCs | 50% | 0% | 0% | 100% | 0% | ns | NA | NA | NA | 0.002 |
| 87-61-6 | 1,2,3-Trichlorobenzene | VOCs | ns | 0% | 0% | 20% | 0% | ns | NA | 20 | NA | NA |
| 67-64-1 | Acetone | VOCs | ns | 0% | 0% | 60% | 0% | ns | NA | NA | NA | 1250 |

**TABLE 2-8 Ecological Summary of CPECs - Detected Chemicals without Screening Levels**
Willamette Cove

| CAS Number | Standard Analyte | Standard Analyte Group | Detection Frequency by Exposure Unit | | | | | | Oregon DEQ-Approved Level II SLVs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Central Beach Exposure Unit | Central Parcel Upland Exposure Unit | East Parcel Upland Exposure Unit | Inner Cove Beach Exposure Unit | West Parcel Upland Exposure Unit | Wharf Road Exposure Unit | PLANTS | INVERTS | BIRDS | MAMMALS |
| 71-43-2 | Benzene | VOCs | ns | 0% | 40% | 60% | 0% | ns | NA | NA | NA | 3300 |
| 108-90-7 | Chlorobenzene | VOCs | ns | 0% | 40% | 40% | 0% | ns | NA | 40 | NA | NA |
| 75-09-2 | Methylene chloride | VOCs | ns | 0% | 20% | 0% | 25% | ns | NA | NA | NA | 730 |
| 78-93-3 | Methylethyl ketone | VOCs | ns | 0% | 0% | 40% | 0% | ns | NA | NA | NA | 200000 |
| 91-20-3 | Naphthalene | VOCs | 33% | 52% | 52% | 67% | 9% | ns | 10 | NA | NA | 3900 |
| 95-47-6 | o-Xylene | VOCs | ns | 0% | 20% | 60% | 0% | ns | 1 | NA | NA | NA |
| 100-42-5 | Styrene | VOCs | ns | 0% | 40% | 80% | 0% | ns | 300 | NA | NA | NA |
| 108-88-3 | Toluene | VOCs | ns | 0% | 40% | 100% | 0% | ns | 200 | NA | NA | 1440 |
| 1330-20-7 | Xylene | VOCs | ns | 0% | 40% | 100% | 0% | ns | 100 | NA | NA | 120 |

Notes:
NA = not available
ns = not sampled
(a) DEQ directed the multi-incremental (MIS) sampling of the three Wharf Road EU decision units to support the risk analysis for the Facility.

# TABLE 3-1 Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - American Robin

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

## Modeled Receptor: American Robin (insectivorous and omnivorous diets)

## Intake Equations:

**Equation (a) - total CPEC intake**

$$Intake_{total} = Intake_{food} + Intake_{water} + Intake_{soil}$$

**Parameters - Equation (a):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{food}$ | average daily intake from ingestion of prey items (vegetation and animal tissues). | mg/kg | calculated | See Equation (b) |
| $Intake_{soil}$ | average daily intake from incidental ingestion of surface soil. | mg/kg | calculated | See Equation (c) |
| $Intake_{water}$ | average daily intake from the ingestion of water. | mg/kg | 0 | No surface water at Upland Facility; water intake assumed to be 0. |

**Equation (b) - CPEC intake from food**

$$Intake_{food} = AUF * \left( \sum_{i=1}^{N} B_{ij} * P_i * FIR \right)$$

**Parameters - Equation (b):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{food}$ | Intake for contaminant (j) in food | mg dw/kg bw-d | calculated | |
| AUF | Area use factor | unitless | 1 | Fraction of food derived from site; area use assumed to be 100% |
| FIR | Food intake rate | kg dw/kg bw-d | 0.207 | WDOE 2012 - food ingestion rate for American Robin |
| $B_{ij}$ | Concentration of contaminant (j) in biota type (i) where $\ln(B_{ij})$ = $Intercept_{ij}$+$Slope_{ij}$*$\ln(Soil_j)$ | mg/kg dw | Copper: $\ln(B_{plants})$=(0.394*$\ln(Soil_j)$)+0.668 | Uptake equations from EPA 2007 (based on Bechtel-Jacobs 1998, Sample et al. 1998, Sample et al. 1999, etc.) |
| | | | Copper: $B_{inverts}$=0.515*$Soil_j$ | |
| | | | Lead: $\ln(B_{plants})$=(0.561*$\ln(Soil_j)$)-1.328 | |
| | | | Lead: $\ln(B_{inverts})$=(0.807*$\ln(Soil_j)$)-0.218 | |
| | | | Zinc: $\ln(B_{plants})$=(0.554*$\ln(Soil_j)$)+1.575 | |
| | | | Zinc: $\ln(B_{inverts})$=(0.328*$\ln(Soil_j)$)+4.449 | |
| | | | Cadmium: $\ln(B_{plants})$=(0.546*$\ln(Soil_j)$)-0.476 | |
| | | | Cadmium: $\ln(B_{inverts})$=(0.795*$\ln(Soil_j)$)+2.114 | |
| | | | Mercury: $\ln(B_{plants})$=(0.544*$\ln(Soil_j)$)-0.996 | |
| | | | Mercury: $\ln(B_{inverts})$=(0.118*$\ln(Soil_j)$)-0.684 | |
| | | | Barium: $B_{plants}$ = 0.156*$Soil_j$ | |
| | | | Barium: $B_{inverts}$=0.091*$Soil_j$ | |
| | | | Aroclors: $B_{plants}$=0.14*Soilj | |
| | | | Aroclors: $\ln(B_{inverts})$=(1.361*$\ln(Soil_j)$)+1.410 | |
| | | | Dioxins: $B_{inverts}$ = ((10^(0.87*logKow - 2.0))/0.16)/(0.01*Koc))*$Soil_j$ | Uptake equations for organics from EPA (2007); Koc/Kow values from EPA (2013) and are presented on pertinent tables. |
| N | total number of ingested prey types | unitless | 2 | EPA 1993 - American robin diet |
| $P_i$ | Fraction of food as prey $type_i$ | unitless | Plants - 0.29 | EPA 1993 - American robin diet - omnivorous |
| | | | Invertebrates - 0.71 | |
| | | | Plants - 0 | Insectivorous diet |
| | | | Invertebrates - 1 | |

# TABLE 3-1 Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - American Robin

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Equation (c) - CPEC intake from ingested soil**

$$Intake_{soil} = AUF * (FIR * P_s * C_{js} * AF_{js})$$

**Parameters - Equation (c):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{soil}$ | Intake for contaminant (j) in soil | mg dw/kg bw-d | calculated | |
| $C_{js}$ | Concentration of contaminant (j) in soil (s) | mg/kg dw | available data | All available site-wide sample data |
| FIR | Food intake rate | kg dw/kg bw-d | 0.207 | WDOE 2012 - food ingestion rate for American Robin |
| $P_s$ | Proportion of total mass intake that is soil | kg soil/kg food | 15.15% | EPA 2007 - average of 90th percentile values for avian granivore and avian insectivore [1] |
| | | | 16.40% | EPA 2007 - 90th percentile values for avian insectivore [1] |
| $AF_{js}$ | Bioavailability factor of contaminant (j) in soil | unitless | 1 | Bioavailability of all other analytes from ingested soil and food was conservatively assumed to be 100%. |
| $P_i$ | Fraction of food as prey $type_i$ | unitless | Plants - 0.29 | EPA 1993 - American robin diet - omnivorous |
| | | | Invertebrates - 0.71 | |
| | | | Plants - 0 | Insectivorous diet |
| | | | Invertebrates - 1 | |
| AUF | Area use factor | unitless | 1 | Fraction of food derived from site; area use assumed to be 100% for each exposure unit |

Notes:

1 - Mourning dove and American woodcock are surrogate species for avian granivore and avian insectivore, respectively.

mg - milligram dw - dry weight

kg - kilogram bw - body weight

d - day

Diesel range hydrocarbons not evaluated in this Level II expanded assessment.

Koc = organic carbon normalized soil-water partition coefficient for organic compounds

Kow = octanol-water partition coefficient

Sources:


Bechtel-Jacobs. 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. Bechtel-Jacobs Company LLC, Oak Ridge, TN. BJC/OR-133.

Sample, B. E, J. J. Beauchamp, R. A. Efroymson, and G. W. Suter, II. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory ES/ER/TM-219. Lockheed Martin Energy Systems Environmental Restoration Program.

Sample B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II, and T.L. Ashwood. 1999. Literature-derived bioaccumulation models for earthworms: development and validation. Environmental Toxicology and Chemistry 18: 2110-2120.

United States Environmental Protection Agency (EPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/1987a. Volumes I & II.

United States Environmental Protection Agency (EPA). 2007. Attachment 4-1, Guidance for Developing Ecological Soil-Screening Levels (Eco-SSLs), OSWER Directive 9285.7-55 (issued November 2003, revised February 2005, revised April 2007).

United States Environmental Protection Agency (EPA). 2013. Mid-Atlantic Risk Assessment Regional Screening Level (RSL) Chemical-specific Parameters Supporting Table (November 2013). Available at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm (website last updated December 2, 2013).

Washington State Department of Ecology (WDOE). 2012. Table 749-4: Wildlife Exposure Model for Site-Specific Evaluations Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-4.pdf Taken from: Table Terrestrial Ecological Evaluation (TEE) Process- The Site-Specific Evaluation. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/site-specific.htm. Toxics Cleanup Program, Model Toxics Control Act Cleanup (MTCA) Regulation. Accessed 6/22/2012.

# TABLE 3-2 Ecological Benchmark Values (EBVs) - American Robin

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** American Robin (insectivorous and omnivorous diets)

| Analyte | Ecological Benchmark Value | Units | Type of Value | Source/Notes |
|---|---|---|---|---|
| Barium | 208 | mg dw/kg bw-d | NOAEL | Johnson et al. 1960, as reported in ORNL Wildlife TRVs (Sample 1996) |
| | 416 | | LOAEL | Johnson et al. 1960, as reported in ORNL Wildlife TRVs (Sample 1996) |
| Cadmium | 1.45 | mg dw/kg bw-d | NOAEL | White and Finley 1978, as reported in ORNL Wildlife TRVs (Sample 1996) |
| | 6.4 | | LOAEL | Oregon DEQ (2013) preferred value (cited as geomean of toxicity data presented in EcoSSL [EPA 2005c]) |
| | 20.03 | | LOAEL | White and Finley 1978, as reported in ORNL Wildlife TRVs (Sample 1996) |
| Copper | 4.05 | mg dw/kg bw-d | NOAEL | Oregon DEQ (2013) preferred value - (cited as EPA 2007b). |
| | 12.1 | | LOAEL | Oregon DEQ (2013) preferred value - (cited as LOAEL from same study as NOAEL in EPA 2007b). |
| | 18.5 | | NOAEL | "Geometric mean of NOAELs for reproduction and growth" (Figure 5-1 in EPA 2007a) |
| | 30.7 | | LOAEL | Jackson and Stevenson (1981) as cited in EcoSSL (EPA 2007a) |
| Lead | 1.6 | mg dw/kg bw-d | NOAEL | "Highest bounded NOAEL, lower than lowest bounded LOAEL for reproduction, growth, or survival" (Figure 5-1 in EPA 2005a), as used in Portland Harbor BERA (LWG 2011) |
| | 3.3 | | LOAEL | Based on EcoSSL data, as used in Portland Harbor BERA (LWG 2011) |
| Mercury (elemental) | 0.45 | mg dw/kg bw-d | NOAEL | Sample et al. (1996) |
| | 0.9 | | LOAEL | Sample et al. (1996) |
| Total Aroclors | 0.29 | mg dw/kg bw-d | NOAEL | Britton and Huston (1973) |
| | 0.58 | | LOAEL | Britton and Huston (1973) |
| Zinc | 66.1 | mg dw/kg bw-d | NOAEL | Geometric mean of NOAELs for reproduction and growth from EcoSSL (EPA 2007b) as used in Portland Harbor BERA |
| | 171.0 | | LOAEL | Geometric mean of LOAELs for reproduction and growth from EcoSSL (EPA 2007b) as used in Portland Harbor BERA |
| 2,3,7,8-TCDF | 0.000140 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 0.00140 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 2,3,7,8-TCDD | 0.000014 | mg dw/kg bw-d | NOAEL | Nosek et al. 1992 |
| | 0.00014 | | LOAEL | Nosek et al. 1992 |
| 1,2,3,7,8-PeCDF | 0.000980 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.03 |
| | 0.00980 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.03 |
| 2,3,4,7,8-PeCDF | 0.000098 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.3 |
| | 0.00098 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.3 |
| 1,2,3,7,8-PeCDD | 0.000014 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 1 |
| | 0.00014 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 1 |
| 1,2,3,4,7,8-HxCDF | 0.000140 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 0.00140 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,6,7,8-HxCDF | 0.000140 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 0.00140 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 2,3,4,6,7,8-HxCDF | 0.000140 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 0.00140 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,7,8,9-HxCDF | 0.000140 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 0.00140 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,4,7,8-HxCDD | 0.000140 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 0.00140 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,6,7,8-HxCDD | 0.000140 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 0.00140 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,7,8,9-HxCDD | 0.000140 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 0.00140 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,4,6,7,8-HpCDF | 0.001400 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| | 0.01400 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| 1,2,3,4,7,8,9-HpCDF | 0.001400 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| | 0.01400 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| 1,2,3,4,6,7,8-HpCDD | 0.001400 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| | 0.01400 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| OCDF | 0.098000 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.0003 |
| | 0.98000 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.0003 |
| OCDD | 0.098000 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.0003 |
| | 0.98000 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.0003 |

Notes:
BERA = Baseline Ecological Risk Assessment
EcoSSL = Ecological Soil Screening Levels
LOAEL = Lowest Observed Adverse Effects Level
LWG = Lower Willamette Group
mg dw/kg bw-d = milligrams of dry weight per kilogram of body weight per day

# TABLE 3-2  Ecological Benchmark Values (EBVs) - American Robin

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

NOAEL = No Observed Adverse Effects Level
ORNL = Oak Ridge National Laboratory
Diesel range hydrocarbons not evaluated in this Level II expanded assessment.

Sources:


Britton, W. and T. Huston. 1973. Influence of polychlorinated biphenyls in the laying hen. Poultry Science. 52: pp. 1620-1624.

Heinz, G.H. 1975. Effects of methylmercury on approach and avoidance behavior of mallard ducklings. Bulletin of Environmental Contamination and Toxicology. 13: 554-564.

Heinz, G.H. 1979. Methylmercury: Reproductive and behavioral effects on three generations of mallard ducks. The Journal of Wildlife Management. 43: 394-401.

Lower Willamette Group (LWG). 2011. Portland Harbor RI/FS. Draft Final Remedial Investigation Report. Appendix G. BERA. July 1, 2011.

Nosek, J.A., Craven, S.R., Sullivan, J.R., Hurley, S.S., and R.E. Peterson. 1992. Toxicity and reproductive effects of 2,3,7,8-tetrachlorodibenzo-p-dioxin in ring-necked pheasants. Journal of Toxicology and Environmental Health. 35: 198-198.

Oregon DEQ (Oregon Department of Environmental Quality). 2013.  Letter from Kenneth Thiessen (Oregon DEQ) to Dwight Leisle (Port) re: comments on "Draft Residual Human Health and Ecological Risk Residual Assessments Willamette Cove Upland Facility. ECSI# 2066".  July 19, 2013.

Sample, B.E., Opresko, D.M., and G.W. Sutter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp. ES/ER/TM-86/R3.

United States Environmental Protection Agency (EPA). 2005a. Ecological Soil Screening Levels for Lead, Interim Final. OSWER Directive 9285.7-70 (March 2005).

United States Environmental Protection Agency (EPA). 2005b. Ecological Soil Screening Levels for Vanadium. Interim Final. OSWER Directive 9285.7-75 (April 2005).

United States Environmental Protection Agency (EPA). 2005c. Ecological Soil Screening Levels for Cadmium. Interim Final. OSWER Directive 9285.7-65 (March 2005).

United States Environmental Protection Agency (EPA). 2007a. Ecological Soil Screening Levels for Copper, Interim Final. OSWER Directive 9285.7-68 (Issued July 2006; Revised February 2007).

United States Environmental Protection Agency (EPA). 2007. Ecological Soil Screening Levels for Zinc, Interim Final. OSWER Directive 9285.7-73 (June 2007).

World Health Organization (WHO). 2006. 2005 Re-evaluation of human and mammalian toxic quivalency factors (TEFs) for dioxins and dioxin-like compouds. Tox. Sci. 93(2) 231-241.

# TABLE 3-3 Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - Red-tailed Hawk

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

## Modeled Receptor: Red-tailed Hawk

## Intake Equations:

**Equation (a) - total CPEC intake**

$$Intake_{total} = Intake_{food} + Intake_{water} + Intake_{soil}$$

**Parameters - Equation (a):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{food}$ | average daily intake from ingestion of prey items (animal tissues). | mg/kg | calculated | See Equation (b) |
| $Intake_{soil}$ | average daily intake from incidental ingestion of surface soil. | mg/kg | calculated | See Equation (c) |
| $Intake_{water}$ | average daily intake from the ingestion of water. | mg/kg | 0 | No surface water at Upland Facility; water intake assumed to be 0. |

**Equation (b) - CPEC intake from food**

$$Intake_{food} = AUF * \left( \sum_{i=1}^{N} B_{ij} * P_i * FIR \right)$$

**Parameters - Equation (b):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{food}$ | Intake for contaminant (j) in food | mg dw/kg bw-d | Calculated | |
| AUF | Area use factor | unitless | West Parcel Upland EU (4.85 acres): 0.003<br>Central Parcel Upland EU (9.92 acres): 0.006<br>East Parcel EU (7.41 acres): 0.004<br>Central Beach EU (0.43 acres): 0.0002<br>Inner Cove Beach EU (1.41 acres): 0.0008<br>Wharf Road EU (0.34 acres): 0.0002<br>Site (24.02 acres): 0.01 | Fraction of food derived from site. Area use based on Red-tailed Hawk home range of 1722.3 acres (average of territory sizes - Michigan fields/woodlots; EPA 1993), adjusted for each EU. |
| FIR | Food intake rate | kg dw/kg bw-d | 0.0353 | EPA 2007 - high-end value for red-tailed hawk |
| Bij | Concentration of contaminant (j) in biota type (i) | mg/kg dw | Calculated - See Table 3-4 | |
| N | Total number of ingested prey types | unitless | 1 | EPA 1993 - Red-tailed hawk diet[1] |
| $P_i$ | Fraction of food as prey type$_i$ | unitless | Small vertebrates - 1 | EPA 1993 - Red-tailed hawk diet[1] |

## TABLE 3-3 Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - Red-tailed Hawk

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

## Modeled Receptor: Red-tailed Hawk

## Intake Equations:

**Equation (c) - CPEC intake from ingested soil**

$$Intake_{soil} = AUF * (FIR * P_s * C_{js} * AF_{js})$$

**Parameters - Equation (c):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{soil}$ | Intake for contaminant (j) in soil | mg dw/kg bw-d | calculated | |
| $C_{js}$ | Concentration of contaminant (j) in soil (s) | mg/kg dw | available data | All available site-wide sample data |
| FIR | Food intake rate | kg dw/kg bw-d | 0.0353 | EPA 2007 - high-end value for hawk |
| $P_s$ | Proportion of total mass intake that is soil | kg soil/kg food | 0.057 | EPA 2007 - 90th percentile value for hawk |
| $AF_{js}$ | Bioavailability factor of contaminant (j) in soil | unitless | 100% | Bioavailability of all analytes from ingested soil (and food) was conservatively assumed to be 100%. |
| AUF | Area use factor | unitless | West Parcel Upland EU (4.85 acres): 0.003<br>Central Parcel Upland EU (9.92 acres): 0.006<br>East Parcel EU (7.41 acres): 0.004<br>Central Beach EU (0.43 acres): 0.0002<br>Inner Cove Beach EU (1.41 acres): 0.0008<br>Wharf Road EU (0.34 acres): 0.0002<br>Site (24.02 acres): 0.01 | Fraction of food derived from site. Area use based on Red-tailed Hawk home range of 1722.3 acres (average of territory sizes - Michigan fields/woodlots; EPA 1993), adjusted for each EU. |

Notes:

1 - Red-tailed hawk diet consists of small vertebrates, such as small mammals, birds, lizards, snakes (EPA 1993). This analysis models dietary inputs using small mammals as representative prey.

mg - milligram    dw - dry weight

kg - kilogram    bw - body weight

d - day    EU - exposure unit

Sources:


United States Environmental Protection Agency (EPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/1987a. Volumes I & II.

United States Environmental Protection Agency (EPA). 2007. Attachment 4-1, Guidance for Developing Ecological Soil-Screening Levels (Eco-SSLs), OSWER Directive 9285.7-55 (issued November 2003, revised February 2005, revised April 2007).

## TABLE 3-4 Small Mammal Uptake Factors - Bioaccumulative Chemicals

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Red-tailed Hawk and Long-tailed Weasel

| Analyte | Koc (L/kg) | | LogKow | | Bij = Concentration of contaminant (j) in biota type (i) (mg/kg dw) | | Source/Notes |
|---|---|---|---|---|---|---|---|
| | Value | Source | Value | Source | Concentration in earthworm (Ce), as needed to calculate for small mammals | Concentration in small mammals (Cm) | |
| Mercury | NA | | NA | | --- | Cm = 0.192*Soilj | Sample et al. 1998 |
| Sum DDx | NA | | NA | | Ce = 11.2*Soilj | Cm = 4.83 * Ce | EcoSSL (EPA 2007) Attachment 4-1 |
| beta-Endosulfan | 6761 | EPI | 3.5 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| beta-Hexachlorocyclohexane | 2807 | EPI | 4.26 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| Endrin | 20090 | EPI | 5.45 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| Total Endosulfan | 6761 | EPI | 3.5 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| Aroclor 1254 | 130500 | EPI | 6.50 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| Aroclor 1260 | 349700 | EPI | 7.55 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| Total Aroclors | NA | | NA | | Ce = EXP(1.41+1.361*LN(Soilj)) | Cm = Ce * BAFd-m (where BAFd-m = 1) | Sample et al. 1998 |
| 2,3,7,8-TCDF | 282000 | EPI | 7.92 | EPI | --- | Cm = 0.1251 * Soilj | Sample et al. 1998 |
| 2,3,7,8-TCDD | 282000 | EPI | 7.92 | EPI | --- | Cm = EXP(0.8133 + 1.0933 x ln(Soilj)) | Sample et al. 1998 |
| 1,2,3,7,8-PeCDF | 312300 | EPI | 8.20 | EPI | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 2,3,4,7,8-PeCDF | 282000 | EPI | 7.92 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 1,2,3,7,8-PeCDD | 282000 | EPI | 7.92 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 1,2,3,4,7,8-HxCDF | 182900 | EPI | 7.58 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 1,2,3,6,7,8-HxCDF | 282000 | EPI | 7.92 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 2,3,4,6,7,8-HxCDF | 242100 | EPI | 7.80 | EPI | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 1,2,3,4,7,8-HxCDD | 408000 | EPI | 8.21 | EPIest | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 1,2,3,6,7,8-HxCDD | 66870 | EPI | 6.92 | EPI | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 1,2,3,7,8,9-HxCDD | 66870 | EPI | 6.92 | EPI | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 1,2,3,4,6,7,8-HpCDF | 55240 | EPI | 6.64 | EPI | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 1,2,3,4,7,8,9-HpCDF | 48020 | EPI | 6.53 | EPI | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| 1,2,3,4,6,7,8-HpCDD | 67730 | EPI | 6.80 | EPI | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| OCDF | 670500 | EPI | 8.60 | EPI | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |
| OCDD | 402900 | EPI | 8.20 | EPI | Ce = ((10^(0.87 * logKow -2.0))/0.16)/(0.01* Koc))*Soilj | Cm = Ce * BAFd-m (where BAFd-m = 1) | EcoSSL (EPA 2007) Attachment 4-1 |

Notes:

Koc = organic carbon normalized soil-water partition coefficient for organic compounds

Kow = octanol-water partition coefficient

BAF = bioaccumulation factor

BAF d-m = Bioaccumulation factor from diet to mammal

$B_{ij}$ = Concentration of contaminant (j) in biota type (i) (mg/kg dw)

Ce = concentration in earthworms

Cm = concentration in small mammals

mg/kg dw = milligrams per kilogram in dry weight

NA = not applicable

Soilj = Concentration of contaminant (j) in soil (mg/kg)

$K_{oc}/K_{ow}$ values and source (EPI) are from EPA's Regional Screening Level (RSL) Chemical-specific Parameters Supporting Table (EPA 2013).

EPIest = No empirical Log $K_{ow}$, estimated value used from EPIWin Software (EPA 2012).

Only aroclors, dioxin/furan congeners, and pesticides detected at the Site are included in the analysis.

Sources:

Sample, B. E, J. J. Beauchamp, R. A. Efroymson, and G. W. Suter, II. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory ES/ER/TM-219. Lockheed Martin Energy Systems Environmental Restoration Program.

United States Environmental Protection Agency (EPA). 2007. Attachment 4-1, Guidance for Developing Ecological Soil-Screening Levels (Eco-SSLs), OSWER Directive 9285.7-55 (issued November 2003, revised February 2005, revised April 2007).

United States Environmental Protection Agency (EPA). 2012. EPISuite Software v 4.11 (November 2012). Available at http://www.epa.gov/oppt/exposure/pubs/episuitedl.htm. Accessed November 2013.

United States Environmental Protection Agency (EPA). 2013. Mid-Atlantic Risk Assessment Regional Screening Level (RSL) Chemical-specific Parameters Supporting Table (November 2013). Available at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm (website last updated December 2, 2013).

# TABLE 3-5  Ecological Benchmark Values (EBVs) - Red-tailed Hawk

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Red-tailed Hawk

| Analyte | Ecological Benchmark Value (mg dw/kg bw-d) | | Source/Notes |
|---|---|---|---|
| | NOAEL | LOAEL | |
| Mercury (elemental) | 0.45 | 0.9 | Sample et al. (1996) |
| Sum DDx | 0.227 | 2.27 | EcoSSL DDT and Metabolites (EPA 2007) |
| beta-Endosulfan | 10 | NA | Sample et al. (1996) |
| beta-Hexachlorocyclohexane | 0.56 | 2.25 | Sample et al. (1996) |
| Endrin | 0.01 | 0.1 | Sample et al. (1996) |
| Total Endosulfan | 10 | NA | Sample et al. (1996) |
| Aroclor 1254 | 0.29 | 0.58 | Britton and Huston (1973) |
| Aroclor 1260 | 0.29 | 0.58 | Britton and Huston (1973) |
| Total Aroclors | 0.29 | 0.58 | Britton and Huston (1973) |
| 2,3,7,8-TCDF | 1.40E-04 | 1.40E-03 | WHO (2006) 2,3,7,8-TCDD TEF = 0.1 |
| 2,3,7,8-TCDD | 1.40E-05 | 1.40E-04 | Nosek et al. 1992 |
| 1,2,3,7,8-PeCDF | 9.80E-04 | 9.80E-03 | WHO (2006) 2,3,7,8-TCDD TEF = 0.03 |
| 2,3,4,7,8-PeCDF | 9.80E-05 | 9.80E-04 | WHO (2006) 2,3,7,8-TCDD TEF = 0.3 |
| 1,2,3,7,8-PeCDD | 1.40E-05 | 1.40E-04 | WHO (2006) 2,3,7,8-TCDD TEF = 1 |
| 1,2,3,4,7,8-HxCDF | 1.40E-04 | 1.40E-03 | WHO (2006) 2,3,7,8-TCDD TEF = 0.1 |
| 1,2,3,6,7,8-HxCDF | 1.40E-04 | 1.40E-03 | WHO (2006) 2,3,7,8-TCDD TEF = 0.1 |
| 2,3,4,6,7,8-HxCDF | 1.40E-04 | 1.40E-03 | WHO (2006) 2,3,7,8-TCDD TEF = 0.1 |
| 1,2,3,4,7,8-HxCDD | 1.40E-04 | 1.40E-03 | WHO (2006) 2,3,7,8-TCDD TEF = 0.1 |
| 1,2,3,6,7,8-HxCDD | 1.40E-04 | 1.40E-03 | WHO (2006) 2,3,7,8-TCDD TEF = 0.1 |
| 1,2,3,7,8,9-HxCDD | 1.40E-04 | 1.40E-03 | WHO (2006) 2,3,7,8-TCDD TEF = 0.1 |
| 1,2,3,4,6,7,8-HpCDF | 1.40E-03 | 1.40E-02 | WHO (2006) 2,3,7,8-TCDD TEF = 0.01 |
| 1,2,3,4,7,8,9-HpCDF | 1.40E-03 | 1.40E-02 | WHO (2006) 2,3,7,8-TCDD TEF = 0.01 |
| 1,2,3,4,6,7,8-HpCDD | 1.40E-03 | 1.40E-02 | WHO (2006) 2,3,7,8-TCDD TEF = 0.01 |
| OCDF | 9.80E-02 | 9.80E-01 | WHO (2006) 2,3,7,8-TCDD TEF = 0.0003 |
| OCDD | 9.80E-02 | 9.80E-01 | WHO (2006) 2,3,7,8-TCDD TEF = 0.0003 |

Notes:

EcoSSL = Ecological Soil Screening Levels

LOAEL = Lowest Observed Adverse Effects Level

mg dw/kg bw-d = milligrams of dry weight per kilogram of body weight per day

NA = not available

NOAEL = No Observed Adverse Effects Level

TEF = Toxic Equivalency Factor

Only aroclors, dioxin/furan congeners, and pesticides detected at the Site are included in the analysis.

Sources:


Britton, W. and T. Huston. 1973. Influence of polychlorinated biphenyls in the laying hen. Poultry Science. 52: pp. 1620-1624.

Heinz, G.H. 1975. Effects of methylmercury on approach and avoidance behavior of mallard ducklings. Bulletin of Environmental Contamination and Toxicology. 13: 554-564.

Heinz, G.H. 1979. Methylmercury: Reproductive and behavioral effects on three generations of mallard ducks. The Journal of Wildlife Management. 43: 394-401.

Nosek, J.A., Craven, S.R., Sullivan, J.R., Hurley, S.S., and R.E. Peterson. 1992. Toxicity and reproductive effects of 2,3,7,8-tetrachlorodibenzo-p-dioxin in ring-necked pheasants. Journal of Toxicology and Environmental Health. 35: 198-198.

Sample, B.E., Opresko, D.M., and G.W. Sutter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp. ES/ER/TM-86/R3.

World Health Organization (WHO). 2006. 2005 Re-evaluation of human and mammalian toxic quivalency factors (TEFs) for dioxins and dioxin-like compounds. Tox. Sci. 93(2) 231-241

United States Environmental Protection Agency (EPA). 2007. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-57 (April 2007).

## TABLE 3-6 Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - Short-tailed Shrew
**Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils**

## Modeled Receptor: Short-tailed Shrew

## Intake Equations:

**Equation (a) - total CPEC intake**

$$Intake_{total} = Intake_{food} + Intake_{water} + Intake_{soil}$$

**Parameters - Equation (a):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{food}$ | average daily intake from ingestion of prey items (vegetation and animal tissues). | mg/kg | calculated | See Equation (b) |
| $Intake_{soil}$ | average daily intake from incidental ingestion of surface soil. | mg/kg | calculated | See Equation (c) |
| $Intake_{water}$ | average daily intake from the ingestion of water. | mg/kg | 0 | No surface water at Upland Facility; water intake assumed to be 0. |

**Equation (b) - CPEC intake from food**

$$Intake_{food} = AUF * \left( \sum_{i=1}^{N} B_{ij} * P_i * FIR \right)$$

**Parameters - Equation (b):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{food}$ | Intake for contaminant (j) in food | mg dw/kg bw-d | calculated | |
| AUF | Area use factor | unitless | 1 | Fraction of food derived from site; area use assumed to be 100% |
| FIR | Food intake rate | kg dw/kg bw-d | 0.209 | EPA 2007 - food ingestion rate for shrew |
| $B_{ij}$ | Concentration of contaminant (j) in biota type (i) where $\ln(B_{ij})$ = $Intercept_{ij}$+$Slope_{ij}$*$\ln(Soil_j)$ | mg/kg dw | Copper: $\ln(B_{plants})$=(0.394*$\ln(Soil_j)$)+0.668 | Uptake equations from Table 4a in EPA 2007 (based on Bechtel-Jacobs 1998, Sample et al. 1998, Sample et al. 1999, etc.) |
| | | | Copper: $B_{inverts}$=0.515*$Soil_j$ | |
| | | | Lead: $\ln(B_{plants})$=(0.561*$\ln(Soil_j)$)-1.328 | |
| | | | Lead: $\ln(B_{inverts})$=(0.807*$\ln(Soil_j)$)-0.218 | |
| | | | Zinc: $\ln(B_{plants})$=(0.554*$\ln(Soil_j)$)+1.575 | |
| | | | Zinc: $\ln(B_{inverts})$=(0.328*$\ln(Soil_j)$)+4.449 | |
| | | | Cadmium: $\ln(B_{plants})$=(0.546*$\ln(Soil_j)$)-0.476 | |
| | | | Cadmium: $\ln(B_{inverts})$=(0.795*$\ln(Soil_j)$)+2.114 | |
| | | | Antimony: $\ln(B_{plants})$ =(0.938*ln(Soilj))-3.233 | |
| | | | Antimony: $B_{inverts}$=Soilj | |
| | | | HPAHs: $\ln(B_{plants})$=0.9469*ln(Soilj)-1.7026 | |
| | | | HPAHs: $B_{inverts}$=2.6*Soilj | |
| | | | Aroclors: $B_{plants}$=0.14*Soilj | |
| | | | Aroclors: $\ln(B_{inverts})$=(1.361*$\ln(Soil_j)$)+1.410 | |
| | | | Dioxins: $B_{inverts}$ = ((10^(0.87*logKow - 2.0))/0.16)/(0.01*Koc))*$Soil_j$ | Uptake equations for organics from EPA (2007); Koc/Kow values from EPA (2013) and are presented on pertinent tables. |
| N | total number of ingested prey types | unitless | 1 | EPA 2007 - shrew diet |
| $P_i$ | Fraction of food as prey $type_i$ | unitless | Plants - 0 | EPA 2007 - shrew diet |
| | | | Invertebrates - 1 | |
| | | | Plants - 0.5 | Omnivorous diet |
| | | | Invertebrates - 0.5 | |

## TABLE 3-6 Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - Short-tailed Shrew
**Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils**

**Modeled Receptor:** Short-tailed Shrew

**Equation (c) - CPEC intake from ingested soil**

$$Intake_{soil} = AUF * (FIR * P_s * C_{js} * AF_{js})$$

**Parameters - Equation (c):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{soil}$ | Intake for contaminant (j) in soil | mg dw/kg bw-d | calculated | |
| $C_{js}$ | Concentration of contaminant (j) in soil (s) | mg/kg dw | available data | All available site-wide sample data |
| FIR | Food intake rate | kg dw/kg bw-d | 0.209 | EPA 2007 - food ingestion rate for shrew |
| $P_s$ | Proportion of total mass intake that is soil | kg soil/kg food | 0.03 | EPA 2007 - soil ingestion rate for shrew |
| $AF_{js}$ | Bioavailability factor of contaminant (j) in soil | unitless | 1 | Bioavailability of all other analytes from ingested soil and food was conservatively assumed to be 100%. |
| $P_i$ | Fraction of food as prey $type_i$ | unitless | Plants - 0<br>Invertebrates - 1 | EPA 2007 - shrew diet |
| | | | Plants - 0.5<br>Invertebrates - 0.5 | Omnivorous diet |
| AUF | Area use factor | unitless | 1 | Fraction of food derived from site; area use assumed to be 100% |

Notes:

mg - milligram dw - dry weight

kg - kilogram bw - body weight

d - day

Koc = organic carbon normalized soil-water partition coefficient for organic compounds

Kow = octanol-water partition coefficient

HPAHs - High molecular weight polyaromatic hydrocarbons

Diesel range hydrocarbons and dibenzofuran not evaluated in this Level II expanded assessment.

Sources:


Bechtel-Jacobs. 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. Bechtel-Jacobs Company LLC, Oak Ridge, TN. BJC/OR-133.

Ruby, M.V., A. Davis, J.H. Kempton, J.W. Drexler, and P.D. Bergstrom. 1992. Lead Bioavailability: Dissolution Kinetics under Simulated Gastric Conditions. Environmental Science and Technology. 26:1242-1248.

Sample, B. E, J. J. Beauchamp, R. A. Efroymson, and G. W. Suter, II. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory ES/ER/TM-219. Lockheed Martin Energy Systems Environmental Restoration Program.

Sample B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II, and T.L. Ashwood. 1999. Literature-derived bioaccumulation models for earthworms: development and validation. Environmental Toxicology and Chemistry 18: 2110-2120.

Schoof, R.A. 2003. Guide for Incorporating Bioavailability Adjustments into Human Health and Ecological Risk Assessments at U. S. Department of Defense Facilities Part 1: Overview of Metals Bioavailability (Final).

Suedel , B.C., A. Nicholson, C.H. Day, J. Spicer II. 2006. The value of metals bioavailability and speciation in formation for ecological risk assessment in arid soils. Integrated Environmental Assessment and Management. 2:355-364.

United States Environmental Protection Agency (EPA). 2007. Attachment 4-1, Guidance for Developing Ecological Soil-Screening Levels (Eco-SSLs), OSWER Directive 9285.7-55 (issued November 2003, revised February 2005, revised April 2007).

## TABLE 3-7 Ecological Benchmark Values (EBVs) - Short-tailed Shrew

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Short-tailed Shrew

| Analyte | Ecological Benchmark Value | Units | Type of Value | Source/Notes |
|---|---|---|---|---|
| Antimony | 0.059 | mg dw/kg bw-d | NOAEL | Geometric mean of NOAELs for reproduction and growth (EPA 2005a) |
| | 0.59 | | LOAEL | Poon et al., 1998, as cited in EcoSSL (EPA 2005a) |
| Aroclors | 0.0037 | mg dw/kg bw-d | NOAEL | Restum et al. 1998 |
| | 0.037 | | LOAEL | Restum et al. 1998 |
| Cadmium | 0.77 | mg dw/kg bw-d | NOAEL | Oregon DEQ (2013) preferred value (cited as EcoSSL [EPA 2005c]) |
| | 1 | | NOAEL | Soutou et al., 1980, as reported in ORNL Wildlife TRVs (Sample 1996) |
| | 7.7 | | LOAEL | Oregon DEQ (2013) preferred value - (cited as LOAEL from same study as NOAEL in EPA 2005c). |
| | 10 | | LOAEL | Soutou et al., 1980, as reported in ORNL Wildlife TRVs (Sample 1996) |
| Copper | 5.6 | mg dw/kg bw-d | NOAEL | Oregon DEQ (2013) preferred value (cited as EcoSSL [EPA 2007a]) |
| | 9.34 | | LOAEL | Oregon DEQ (2013) preferred value - (cited as LOAEL from same study as NOAEL in EPA 2007a). |
| | 25 | | NOAEL | Geometric mean of NOAELs for reproduction and growth (EPA 2007a) |
| | 45.7 | | LOAEL | Grobner et al. 1986, as cited in EcoSSL (EPA 2007a) |
| HPAH | 0.615 | mg dw/kg bw-d | NOAEL | EcoSSL document for PAHs (EPA 2007b) |
| | 3.07 | | LOAEL | EcoSSL document for PAHs (EPA 2007b) |
| Lead | 4.7 | mg dw/kg bw-d | NOAEL | TRV used in Portland Harbor BERA; from EcoSSL (EPA 2005b) |
| | 8.9 | | LOAEL | TRV used in Portland Harbor BERA; from EcoSSL (EPA 2005b) |
| Zinc | 75.4 | mg dw/kg bw-d | NOAEL | Geometric mean of NOAELs for reproduction and growth (EPA 2007c) |
| | 103.0 | | LOAEL | Hill et. al., 1983, as cited in EcoSSL (EPA 2007c) |
| 2,3,7,8-TCDF | 2.20E-06 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 2.20E-05 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 2,3,7,8-TCDD | 2.20E-07 | mg dw/kg bw-d | NOAEL | Tillet et al., 1996 as cited in the Portland Harbor BERA (LWG 2011) |
| | 2.20E-06 | | LOAEL | Tillet et al., 1996 as cited in the Portland Harbor BERA (LWG 2011) |
| 1,2,3,7,8-PeCDF | 1.54E-05 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.03 |
| | 1.54E-04 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.03 |
| 2,3,4,7,8-PeCDF | 1.54E-06 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.3 |
| | 1.54E-05 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.3 |
| 1,2,3,7,8-PeCDD | 2.20E-07 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 1 |
| | 2.20E-06 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 1 |
| 1,2,3,4,7,8-HxCDF | 2.20E-06 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 2.20E-05 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,6,7,8-HxCDF | 2.20E-06 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 2.20E-05 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 2,3,4,6,7,8-HxCDF | 2.20E-06 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 2.20E-05 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,7,8,9-HxCDF | 2.20E-06 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 2.20E-05 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,4,7,8-HxCDD | 2.20E-06 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 2.20E-05 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,6,7,8-HxCDD | 2.20E-06 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 2.20E-05 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,7,8,9-HxCDD | 2.20E-06 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| | 2.20E-05 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,4,6,7,8-HpCDF | 2.20E-05 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| | 2.20E-04 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| 1,2,3,4,7,8,9-HpCDF | 2.20E-05 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| | 2.20E-04 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |

## TABLE 3-7 Ecological Benchmark Values (EBVs) - Short-tailed Shrew

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Short-tailed Shrew

| Analyte | Ecological Benchmark Value | Units | Type of Value | Source/Notes |
|---|---|---|---|---|
| 1,2,3,4,6,7,8-HpCDD | 2.20E-05 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| | 2.20E-04 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.01 |
| OCDF | 1.54E-03 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.0003 |
| | 1.54E-02 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.0003 |
| OCDD | 1.54E-03 | mg dw/kg bw-d | NOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.0003 |
| | 1.54E-02 | | LOAEL | WHO (2006) 2,3,7,8 -TCDD TEF = 0.0003 |

Notes:

BERA = Baseline Ecological Risk Assessment

EcoSSL = Ecological Soil Screening Levels

LOAEL = Lowest Observed Adverse Effects Level

LWG = Lower Willamette Group

mg dw/kg bw-d = milligrams of dry weight per kilogram of body weight per day

Mor = Mortality

NOAEL = No Observed Adverse Effects Level

ORNL = Oak Ridge National Laboratory

PCBs - Polychlorinated biphenyls

Rep/Gro = Reproductive/Growth

TRV = Toxicity Reference Value

HPAHs - High molecular weight polyaromatic hydrocarbons

Diesel range hydrocarbons and dibenzofuran not evaluated in this Level II expanded assessment.

Sources:


Lower Willamette Group (LWG). 2011. Portland Harbor RI/FS. Draft Final Remedial Investigation Report. Appendix G. BERA. July 1, 2011

Oregon DEQ (Oregon Department of Environmental Quality). 2013. Letter from Kenneth Thiessen (Oregon DEQ) to Dwight Leisle (Port) re: comments on "Draft Residual Human Health and Ecological Risk Residual Assessments Willamette Cove Upland Facility. ECSI# 2066". July 19, 2013.

Poon, R., Chu, I., Lecavalier, P., Valli, V. E., Foster, W., Gupta, S., and Thomas, B. 1998. Effects of antimony on rats following 90-day exposure via drinking water. Food and Chemical Toxicology. 36(1):21-35.

Restum JC, Bursian SJ, Giesy JP, Render JA, Helferich WG, Shipp EB, Verbrugge DA. 1998. Multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake Huron, on mink. 1. Effects on mink reproduction, kit growth and survival, and selected biological parameters. J Toxicol Environ Health 54(A):343-375

Sample, B.E., Opresko, D.M., and G.W. Sutter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp. ES/ER/TM-86/R3.

United States Environmental Protection Agency (EPA). 2005a. Ecological Soil Screening Levels for Antimony Interim Final. OSWER Directive 9285.7-61 (February

United States Environmental Protection Agency (EPA). 2005b. Ecological Soil Screening Levels for Lead, Interim Final. OSWER Directive 9285.7-70 (March 2005).

United States Environmental Protection Agency (EPA). 2005c. Ecological Soil Screening Levels for Cadmium. Interim Final. OSWER Directive 9285.7-65 (March 20

United States Environmental Protection Agency (EPA). 2007a. Ecological Soil Screening Levels for Copper, Interim Final. OSWER Directive 9285.7-68 (Issued July 2006; Revised February 2007).

United States Environmental Protection Agency (EPA). 2007b. Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons (PAHs). Interim Final. OSWER Directive 9285.7-78 (June 2007).

United States Environmental Protection Agency (EPA). 2007c. Ecological Soil Screening Levels for Zinc, Interim Final. OSWER Directive 9285.7-73 (June 2007).

# TABLE 3-8 Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - Long-tailed Weasel

**Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils**

## Modeled Receptor: Long-tailed weasel

## Intake Equations:

**Equation (a) - total CPEC intake**

$$Intake_{total} = Intake_{food} + Intake_{water} + Intake_{soil}$$

**Parameters - Equation (a):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{food}$ | average daily intake from ingestion of prey items (animal tissues). | mg/kg | calculated | See Equation (b) |
| $Intake_{soil}$ | average daily intake from incidental ingestion of surface soil. | mg/kg | calculated | See Equation (c) |
| $Intake_{water}$ | average daily intake from the ingestion of water. | mg/kg | 0 | No surface water at Upland Facility; water intake assumed to be 0. |

**Equation (b) - CPEC intake from food**

$$Intake_{food} = AUF * \left( \sum_{i=1}^{N} B_{ij} * P_i * FIR \right)$$

**Parameters - Equation (b):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{food}$ | Intake for contaminant (j) in food | mg dw/kg bw-d | calculated | |
| AUF | Area use factor | unitless | West Parcel Upland EU (4.85 acres): 0.023<br>Central Parcel Upland EU (9.92 acres): 0.047<br>East Parcel EU (7.41 acres): 0.035<br>Central Beach EU (0.43 acres): 0.002<br>Inner Cove Beach EU (1.41 acres): 0.0067<br>Wharf Road EU (0.34 acres): 0.0016<br>Site (24.02 acres): 0.12 | Fraction of food derived from site. Area use based on long-tailed weasel home range of 210 acres (midpoint of male home range ranging from 10 to 160 ha; NatureServe Explorer 2013), adjusted for each EU. |
| FIR | Food intake rate | kg dw/kg bw-d | 0.13 | EPA 2007 - high end value for weasel |
| Bij | Concentration of contaminant (j) in biota type (i) where Bij = BAFj*Soilj | mg/kg dw | Calculated - See Table 3-5 | |
| N | Total number of ingested prey types | unitless | 1 | NatureServe Explorer 2013 - Long-tailed weasel diet[1] |
| $P_i$ | Fraction of food as prey type$_i$ | unitless | Small vertebrates - 1 | NatureServe Explorer 2013 - Long-tailed weasel diet[1] |

**Equation (c) - CPEC intake from ingested soil**

$$Intake_{soil} = AUF * (FIR * P_s * C_{js} * AF_{js})$$

**Parameters - Equation (c):**

| Parameter | Description | Units | Value | Source/Notes |
|---|---|---|---|---|
| $Intake_{soil}$ | Intake for contaminant (j) in soil | mg dw/kg bw-d | calculated | |
| $C_{js}$ | Concentration of contaminant (j) in soil (s) | mg/kg dw | available data | All available site-wide sample data |
| FIR | Food intake rate | kg dw/kg bw-d | 0.13 | EPA 2007 - high end value for weasel |
| $P_s$ | Proportion of total mass intake that is soil | kg soil/kg food | 0.043 | EPA 2007 - 90th percentile value for weasel |
| $AF_{js}$ | Bioavailability factor of contaminant (j) in soil | unitless | 100% | Bioavailability of all analytes from ingested soil and food was conservatively assumed to be 100%. |
| AUF | Area use factor | unitless | West Parcel Upland EU (4.85 acres): 0.023<br>Central Parcel Upland EU (9.92 acres): 0.047<br>East Parcel EU (7.41 acres): 0.035<br>Central Beach EU (0.43 acres): 0.002<br>Inner Cove Beach EU (1.41 acres): 0.0067<br>Wharf Road EU (0.34 acres): 0.0016<br>Site (24.02 acres): 0.12 | Fraction of food derived from site. Area use based on long-tailed weasel home range of 210 acres (midpoint of male home range ranging from 10 to 160 ha; NatureServe Explorer 2013), adjusted for each EU. |

Notes:

1 - Long-tailed weasel feeds primarily on small mammals (NatureServe Explorer 2013).

mg - milligram dw - dry weight
kg - kilogram bw - body weight
d - day EU - exposure unit

Sources:


Bechtel-Jacobs. 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. Bechtel-Jacobs Company LLC, Oak Ridge, TN. BJC/OR-133.

NatureServe Explorer. 2013. Long-tailed weasel. Version 7.1; Data last updated: July 2013. Available at http://www.natureserve.org/explorer. Accessed December 2013.

United States Environmental Protection Agency (EPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/1987a. Volumes I & II.

United States Environmental Protection Agency (EPA). 2007. Attachment 4-1, Guidance for Developing Ecological Soil-Screening Levels (Eco-SSLs), OSWER Directive 9285.7-55 (issued November 2003, revised February 2005, revised April 2007).

# TABLE 3-9 Ecological Benchmark Values (EBVs) - Long-tailed Weasel

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Long-tailed Weasel

| Analyte | Ecological Benchmark Value (mg dw/kg bw-d) | | Source/Notes |
|---|---|---|---|
| | NOAEL | LOAEL | |
| Mercury (elemental) | 1 | 5 | Sample et al. (1996), Aurlerich et al. 1974 |
| Sum DDx | 0.147 | 0.735 | EcoSSL DDT and Metabolites (2007) |
| beta-Endosulfan | 0.15 | NA | Sample et al. (1996) |
| beta-Hexachlorocyclohexane | 1.6 | 3.2 | Sample et al. (1996) |
| Endrin | 0.092 | 0.92 | Sample et al. (1996) |
| Total Endosulfan | 0.15 | NA | Sample et al. (1996) |
| Aroclor 1254 | 0.0037 | 0.037 | Restum et. al 1998 |
| Aroclor 1260 | 0.0037 | 0.037 | Restum et. al 1998 |
| Total Aroclors | 0.0037 | 0.037 | Restum et. al 1998 |
| 2,3,7,8-TCDF | 2.20E-06 | 2.20E-05 | WHO (2006)2,3,7,8 -TCDD TEF = 0.1 |
| 2,3,7,8-TCDD | 2.20E-07 | 2.20E-06 | Tillett et al. (1996) |
| 1,2,3,7,8-PeCDF | 1.54E-05 | 1.54E-04 | WHO (2006)2,3,7,8 -TCDD TEF = 0.03 |
| 2,3,4,7,8-PeCDF | 1.54E-06 | 1.54E-05 | WHO (2006)2,3,7,8 -TCDD TEF = 0.3 |
| 1,2,3,7,8-PeCDD | 2.20E-07 | 2.20E-06 | WHO (2006)2,3,7,8 -TCDD TEF = 1 |
| 1,2,3,4,7,8-HxCDF | 2.20E-06 | 2.20E-05 | WHO (2006)2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,6,7,8-HxCDF | 2.20E-06 | 2.20E-05 | WHO (2006)2,3,7,8 -TCDD TEF = 0.1 |
| 2,3,4,6,7,8-HxCDF | 2.20E-06 | 2.20E-05 | WHO (2006)2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,4,7,8-HxCDD | 2.20E-06 | 2.20E-05 | WHO (2006)2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,6,7,8-HxCDD | 2.20E-06 | 2.20E-05 | WHO (2006)2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,7,8,9-HxCDD | 2.20E-06 | 2.20E-05 | WHO (2006)2,3,7,8 -TCDD TEF = 0.1 |
| 1,2,3,4,6,7,8-HpCDF | 2.20E-05 | 2.20E-04 | WHO (2006)2,3,7,8 -TCDD TEF = 0.01 |
| 1,2,3,4,7,8,9-HpCDF | 2.20E-05 | 2.20E-04 | WHO (2006)2,3,7,8 -TCDD TEF = 0.01 |
| 1,2,3,4,6,7,8-HpCDD | 2.20E-05 | 2.20E-04 | WHO (2006)2,3,7,8 -TCDD TEF = 0.01 |
| OCDF | 1.54E-03 | 1.54E-02 | WHO (2006)2,3,7,8 -TCDD TEF = 0.0003 |
| OCDD | 1.54E-03 | 1.54E-02 | WHO (2006)2,3,7,8 -TCDD TEF = 0.0003 |

Notes:
EcoSSL = Ecological Soil Screening Levels
LOAEL = Lowest Observed Adverse Effects Level
mg dw/kg bw-d = milligrams of dry weight per kilogram of body weight per day
NA = not available
NOAEL = No Observed Adverse Effects Level
TEF = Toxic Equivalency Factor

Only aroclors, dioxin/furan congeners, and pesticides detected at the Site are included in the analysis.

Sources:


Aulerich, R. J., R. K. Ringer, and S. Iwamoto. 1974. Effects of dietary mercury on mink. Arch. Environ. Contam. Toxicol. 2: 43-51.

Restum JC, Bursian SJ, Giesy JP, Render JA, Helferich WG, Shipp EB, Verbrugge DA. 1998. Multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake Huron, on mink. 1. Effects on mink reproduction, kit growth and survival, and selected biological parameters. J Toxicol Environ Health 54(A):343-375.

Sample, B.E., D.M. Opresko, and G.W. Suter, II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Risk Assessment Program, Health Sciences Research Division, Oak Ridge, TN. Publication ES/ER/TM-86-R3.

Tillitt DE, Gale RW, Meadows JC, Zajicek JL, Peterman PH, Heaton SN, Jones PD, Bursian SJ, Kubiak TJ, Giesy JP, Aulerich RJ. 1996. Dietary exposure of mink to carp from Saginaw Bay. 3. Characterization of dietary exposure to planar halogenated hydrocarbons, dioxin equivalents, and biomagnification. Environ Sci Technol 30:283-291.

World Health Organization (WHO). 2006. 2005 Re-evaluation of human and mammalian toxic quivalency factors (TEFs) for dioxins and dioxin-like compouds. Tox. Sci. 93(2) 231-241

United States Environmental Protection Agency (EPA). 2007. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-57 (April 2007).

# Table 4-1 Summary of Bird and Mammal Level II Expanded Analyses

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

| Exposure Unit (EU) | CPEC for American Robin | | CPEC for Red-tailed Hawk | | CPEC for Short-tailed Shrew | | CPEC for Long-tailed Weasel | |
|---|---|---|---|---|---|---|---|---|
| | LOAEL TQ greater than 1? [1] | | LOAEL TQ greater than 1? [2] | | LOAEL TQ greater than 1? [1] | | LOAEL TQ greater than 1? [2] | |
| **West Parcel Upland EU** | None | | Mercury | No | None | | Mercury | No |
| | | | Aroclors | No | | | Aroclors | No |
| | | | Pesticides | No | | | Pesticides | No |
| **Central Parcel Upland EU[3]** | Copper | Yes | Mercury | No | Antimony | Yes | Mercury | No |
| | Lead | Yes | Aroclors | No | Copper | Yes | Aroclors | Yes |
| | Zinc | No | Pesticides | No | HPAHs | Yes | Pesticides | No |
| | | | | | Lead | Yes | | |
| | | | | | Zinc | Yes | | |
| **East Parcel Upland EU** | Aroclors | Yes | Mercury | No | Antimony | Yes | Mercury | No |
| | Copper | Yes | Aroclors | No | Aroclors | Yes | Aroclors | Yes |
| | Lead | Yes | Pesticides | No | Copper | Yes | Pesticides | No |
| | Zinc | No | | | Lead | Yes | | |
| | | | | | Zinc | Yes | | |
| **Inner Cove Beach EU** | Aroclors | Yes | Mercury | No | Antimony | Yes | Mercury | No |
| | Barium | No | Aroclors | No | Aroclors | Yes | Aroclors | Yes |
| | Copper | Yes | Pesticides | No | Copper | Yes | Pesticides | No |
| | DRH | ne | | | DRH | ne | | |
| | Lead | Yes | | | Dibenzofuran | ne | | |
| | Mercury | Yes | | | HPAHs | Yes | | |
| | Zinc | No | | | Lead | Yes | | |
| | | | | | Zinc | Yes | | |
| **Central Beach EU** | Cadmium | Yes | Mercury | No | Cadmium | Yes | Mercury | No |
| | | | Aroclors | No | | | Aroclors | No |
| | | | Pesticides | No | | | Pesticides | No |
| **Wharf Road EU [3]** | Dioxins/furans | Yes | Dioxins/furans | No | Dioxin/furans | Yes | Dioxins/furans | Yes |

Notes:

1 = This summary presents the results of the expanded Level II analyses where calculated exposures for robins and shrews with two different modeled diets were compared to NOAEL and LOAEL Ecological Benchmark Values (EBVs) for each chemical. Toxicity quotients (TQs) were calculated for each comparison. CPECs listed on this table as "Yes" are chemicals that have a TQ greater than 1 for the LOAEL comparison for either modeled diet.

2 = This summary presents the results of the expanded Level II analyses for bioaccumulative chemicals. Detected concentrations of mercury, Aroclors, pesticides, (and dioxins for the Wharf Road EU) were the focus of this evaluation. Calculated exposures for red-tailed hawk and long-tailed weasel were compared to NOAEL and LOAEL Ecological Benchmark Values (EBVs) for bioaccumulative chemicals. Toxicity quotients (TQs) were calculated for each comparison. CPECs listed as "Yes" on this table were detected in the EU and have a TQ greater than 1 for the LOAEL comparison.

3 = DEQ directed the multi-incremental (MIS) sampling of the three Wharf Road EU decision units to support the risk analysis for the Facility.

ne = not evaluated in Expanded Level II analyses due to lack of toxicity information.

DRH = diesel-range hydrocarbons

HPAH = High molecular weight polynuclear aromatic hydrocarbons

Refer to Tables 4-2 through 4-21 for expanded Level II analyses.

Total Aroclors refers to the sum of detected Aroclors.

# TABLE 4-2 Exposure Calculation and Comparison to EBVs for American Robin - West Parcel Upland Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

## Modeled Receptor: American Robin (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| No CPECs | NA | NA | NA | NA | NA | NA | NA | NA |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
NA = Not Applicable
TQ - Toxicity Quotient
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-3 Exposure Calculation and Comparison to EBVs for American Robin - Central Parcel Upland Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** American Robin (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| Copper | 1400.0 | 90UCL - Composite samples | 196.77 | 151.90 | 4.05 | NOAEL | 48.6 | 37.5 |
| | | | | | 12.1 | LOAEL | 16.3 | 12.6 |
| | | | | | 18.5 | NOAEL | 10.6 | 8.2 |
| | | | | | 30.7 | LOAEL | 6.4 | 4.9 |
| | 621.1 | 90UCL - Discrete samples | 87.30 | 67.96 | 4.05 | NOAEL | 21.6 | 16.8 |
| | | | | | 12.1 | LOAEL | 7.2 | 5.6 |
| | | | | | 18.5 | NOAEL | 4.7 | 3.7 |
| | | | | | 30.7 | LOAEL | 2.8 | 2.2 |
| | 34 | Background Concentration | 4.78 | 4.11 | 4.05 | NOAEL | 1.2 | 1.0 |
| | | | | | 12.1 | LOAEL | 0.4 | 0.3 |
| | | | | | 18.5 | NOAEL | 0.3 | 0.2 |
| | | | | | 30.7 | LOAEL | 0.2 | 0.1 |
| Lead | 628.1 | 90UCL - Composite samples | 51.47 | 41.70 | 1.6 | NOAEL | 32.2 | 26.1 |
| | | | | | 3.3 | LOAEL | 15.6 | 12.6 |
| | 632.1 | 90UCL - Discrete samples | 51.76 | 41.93 | 1.6 | NOAEL | 32.4 | 26.2 |
| | | | | | 3.3 | LOAEL | 15.7 | 12.7 |
| | 79 | Background Concentration | 8.34 | 6.68 | 1.6 | NOAEL | 5.2 | 4.2 |
| | | | | | 3.3 | LOAEL | 2.5 | 2.0 |
| Zinc | 564.9 | 90UCL - Composite samples | 160.69 | 127.89 | 66.1 | NOAEL | 2.4 | 1.9 |
| | | | | | 171.0 | LOAEL | 0.9 | 0.7 |
| | 408.7 | 90UCL - Discrete samples | 141.13 | 111.28 | 66.1 | NOAEL | 2.1 | 1.7 |
| | | | | | 171.0 | LOAEL | 0.8 | 0.7 |
| | 180 | Background Concentration | 103.36 | 79.84 | 66.1 | NOAEL | 1.6 | 1.2 |
| | | | | | 171.0 | LOAEL | 0.6 | 0.5 |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-4 Exposure Calculation and Comparison to EBVs for American Robin - East Parcel Upland Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** American Robin (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC* | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| Copper | 7795.0 | 90UCL - Composite samples | 1095.61 | 838.45 | 4.05 | NOAEL | 270.5 | 207.0 |
| | | | | | 12.1 | LOAEL | 90.5 | 69.3 |
| | | | | | 18.5 | NOAEL | 59.2 | 45.3 |
| | | | | | 30.7 | LOAEL | 35.7 | 27.3 |
| | 10637.0 | 90UCL - Discrete samples | 1495.06 | 1143.21 | 4.05 | NOAEL | 369.2 | 282.3 |
| | | | | | 12.1 | LOAEL | 123.6 | 94.5 |
| | | | | | 18.5 | NOAEL | 80.8 | 61.8 |
| | | | | | 30.7 | LOAEL | 48.7 | 37.2 |
| | 34 | Background Concentration | 4.78 | 4.11 | 4.05 | NOAEL | 1.2 | 1.0 |
| | | | | | 12.1 | LOAEL | 0.4 | 0.3 |
| | | | | | 18.5 | NOAEL | 0.3 | 0.2 |
| | | | | | 30.7 | LOAEL | 0.2 | 0.1 |
| Lead | 779.7 | 90UCL - Composite samples | 62.37 | 50.61 | 1.6 | NOAEL | 39.0 | 31.6 |
| | | | | | 3.3 | LOAEL | 18.9 | 15.3 |
| | 701.5 | 90UCL - Discrete samples | 56.78 | 46.03 | 1.6 | NOAEL | 35.5 | 28.8 |
| | | | | | 3.3 | LOAEL | 17.2 | 13.9 |
| | 79 | Background Concentration | 8.34 | 6.68 | 1.6 | NOAEL | 5.2 | 4.2 |
| | | | | | 3.3 | LOAEL | 2.5 | 2.0 |
| Total Aroclors | 5.22 | 90UCL - Composite samples | 8.21 | 5.91 | 0.29 | NOAEL | 28.3 | 20.4 |
| | | | | | 0.58 | LOAEL | 14.2 | 10.2 |
| | 0.445 | 90UCL - Discrete samples | 0.30 | 0.22 | 0.29 | NOAEL | 1.0 | 0.8 |
| | | | | | 0.58 | LOAEL | 0.5 | 0.4 |
| Zinc | 431.7 | 90UCL - Composite samples | 144.22 | 113.89 | 66.1 | NOAEL | 2.2 | 1.7 |
| | | | | | 171.0 | LOAEL | 0.8 | 0.7 |
| | 630.1 | 90UCL - Discrete samples | 168.06 | 134.21 | 66.1 | NOAEL | 2.5 | 2.0 |
| | | | | | 171.0 | LOAEL | 1.0 | 0.8 |
| | 180 | Background Concentration | 103.36 | 79.84 | 66.1 | NOAEL | 1.6 | 1.2 |
| | | | | | 171.0 | LOAEL | 0.6 | 0.5 |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
nc = not calculated; 90UCL was not calculated if there were too few samples for proUCL to calculate a 90UCL.
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-5 Exposure Calculation and Comparison to EBVs for American Robin - Inner Cove Beach Exposure Unit

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

## Modeled Receptor: American Robin (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC* | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| Barium | nc | 90UCL | NA | NA | NA | NA | NA | NA |
| | 1060.0 | MDC - Discrete samples | 56 | 57 | 208 | NOAEL | 0.2 | 0.2 |
| | | | | | 416 | LOAEL | 0.1 | 0.1 |
| | 790 | Background Concentration | 42 | 43 | 208 | NOAEL | 0.2 | 0.2 |
| | | | | | 416 | LOAEL | 0.1 | 0.1 |
| Copper | nc | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 744.3 | 90UCL - Discrete samples | 104.61 | 81.26 | 18.5 | NOAEL | 5.7 | 4.4 |
| | | | | | 30.7 | LOAEL | 3.4 | 2.6 |
| | 34 | Background Concentration | 4.78 | 4.11 | 18.5 | NOAEL | 0.3 | 0.2 |
| | | | | | 30.7 | LOAEL | 0.2 | 0.1 |
| Lead | nc | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 4115.0 | 90UCL - Discrete samples | 277.13 | 228.32 | 1.6 | NOAEL | 173.2 | 142.7 |
| | | | | | 3.3 | LOAEL | 84.0 | 69.2 |
| | 79 | Background Concentration | 8.34 | 6.68 | 1.6 | NOAEL | 5.2 | 4.2 |
| | | | | | 3.3 | LOAEL | 2.5 | 2.0 |
| Mercury (elemental) | nc | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 26.04 | 90UCL - Discrete samples | 1.04 | 1.06 | 0.45 | NOAEL | 2.3 | 2.3 |
| | | | | | 0.9 | LOAEL | 1.2 | 1.2 |
| | 0.23 | Background Concentration | 0.10 | 0.08 | 0.45 | NOAEL | 0.2 | 0.2 |
| | | | | | 0.9 | LOAEL | 0.1 | 0.1 |
| Total Aroclors | nc | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 168.2 | 90UCL - Discrete samples | 912.85 | 650.76 | 0.29 | NOAEL | 3147.8 | 2244.0 |
| | | | | | 0.58 | LOAEL | 1573.9 | 1122.0 |
| Zinc | nc | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 480.6 | 90UCL - Discrete samples | 150.52 | 119.23 | 66.1 | NOAEL | 2.3 | 1.8 |
| | | | | | 171.0 | LOAEL | 0.9 | 0.7 |
| | 180 | Background Concentration | 103.36 | 79.84 | 66.1 | NOAEL | 1.6 | 1.2 |
| | | | | | 171.0 | LOAEL | 0.6 | 0.5 |

Notes:

* Diesel range hydrocarbons not evaluated in this Level II expanded assessment.

CPEC - Chemical of Potential Ecological Concern

EPC = Exposure Point Concentration

EBV = Exposure Benchmark Value

NA = Not Applicable

nc = not calculated; 90UCL was not calculated if there were too few samples for proUCL to calculate a 90UCL.

TQ - Toxicity Quotient

90UCL = 90th upper confidence limit on the mean

PCBs - Polychlorinated biphenyls

Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

Total Aroclors refers to the sum of detected Aroclors.

# TABLE 4-6 Exposure Calculation and Comparison to EBVs for American Robin - Central Beach Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** American Robin (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| Cadmium | NA | 90UCL | NA | NA | NA | NA | NA | NA |
| | 17 | MDC | 16.88 | 12.28 | 1.45 | NOAEL | **11.6** | **8.5** |
| | | | | | 6.4 | LOAEL | **2.6** | **1.9** |
| | | | | | 20.03 | LOAEL | 0.8 | 0.6 |
| | 0.63 | Background Concentration | 1.21 | 0.89 | 1.45 | NOAEL | 0.8 | 0.6 |
| | | | | | 6.4 | LOAEL | 0.2 | 0.1 |
| | | | | | 20.03 | LOAEL | 0.1 | 0.0 |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
NA = Not Applicable
nc = not calculated; 90UCL was not calculated if there were too few samples for proUCL to calculate a 90UCL.
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-7 Exposure Calculation and Comparison to EBVs for American Robin - Wharf Road Exposure Unit (Dioxins/Furans Only)

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

## Modeled Receptor: American Robin (insectivorous diet only)

**Toxicity quotient calculations - based on MDC of incremental samples**

| Analyte | EPC - MDC (mg/kg) | Koc | LogKow | Estimated Invert Conc (mg/kg) | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NOAEL | LOAEL | NOAEL | LOAEL |
| 2,3,7,8-TCDF | 0.0000373 | 2.82E+05 | 7.92 | 0.006 | 1.33E-03 | 1.40E-04 | 1.40E-03 | 9.5 | 1.0 |
| 2,3,7,8-TCDD | 0.00000645 | 2.82E+05 | 7.92 | 0.001 | 2.30E-04 | 1.40E-05 | 1.40E-04 | 16.4 | 1.6 |
| 1,2,3,7,8-PeCDF | 0.0000456 | 3.12E+05 | 8.20 | 0.012 | 2.57E-03 | 9.80E-04 | 9.80E-03 | 2.6 | 0.3 |
| 2,3,4,7,8-PeCDF | 0.00159 | 2.82E+05 | 7.92 | 0.274 | 5.67E-02 | 9.80E-05 | 9.80E-04 | 578.9 | 57.9 |
| 1,2,3,7,8-PeCDD | 0.0000848 | 2.82E+05 | 7.92 | 0.015 | 3.03E-03 | 1.40E-05 | 1.40E-04 | 216.1 | 21.6 |
| 1,2,3,4,7,8-HxCDF | 0.000255 | 1.83E+05 | 7.58 | 0.034 | 7.10E-03 | 1.40E-04 | 1.40E-03 | 50.7 | 5.1 |
| 1,2,3,6,7,8-HxCDF | 0.00028 | 2.82E+05 | 7.92 | 0.048 | 9.99E-03 | 1.40E-04 | 1.40E-03 | 71.4 | 7.1 |
| 2,3,4,6,7,8-HxCDF | 0.000652 | 2.42E+05 | 7.80 | 0.103 | 2.13E-02 | 1.40E-04 | 1.40E-03 | 152.2 | 15.2 |
| 1,2,3,7,8,9-HxCDF | Not Detected | 4.08E+05 | 8.21 | Not Applicable | | | | | |
| 1,2,3,4,7,8-HxCDD | 0.000053 | 4.08E+05 | 8.21 | 0.011 | 2.34E-03 | 1.40E-04 | 1.40E-03 | 16.7 | 1.7 |
| 1,2,3,6,7,8-HxCDD | 0.000659 | 6.69E+04 | 6.92 | 0.065 | 1.34E-02 | 1.40E-04 | 1.40E-03 | 95.6 | 9.6 |
| 1,2,3,7,8,9-HxCDD | 0.000333 | 6.69E+04 | 6.92 | 0.033 | 6.76E-03 | 1.40E-04 | 1.40E-03 | 48.3 | 4.8 |
| 1,2,3,4,6,7,8-HpCDF | 0.000449 | 5.52E+04 | 6.64 | 0.030 | 6.31E-03 | 1.40E-03 | 1.40E-02 | 4.5 | 0.5 |
| 1,2,3,4,7,8,9-HpCDF | 0.0000738 | 4.80E+04 | 6.53 | 0.005 | 9.57E-04 | 1.40E-03 | 1.40E-02 | 0.7 | 0.1 |
| 1,2,3,4,6,7,8-HpCDD | 0.00316 | 6.77E+04 | 6.80 | 0.240 | 4.99E-02 | 1.40E-03 | 1.40E-02 | 35.6 | 3.6 |
| OCDF | 0.000366 | 6.71E+05 | 8.60 | 0.104 | 2.14E-02 | 9.80E-02 | 9.80E-01 | 0.2 | 0.0 |
| OCDD | 0.0188 | 4.03E+05 | 8.20 | 3.970 | 8.23E-01 | 9.80E-02 | 9.80E-01 | 8.4 | 0.8 |
| Dioxin/Furan TEQ | Sum of congener TQs | | | | | | | 1307.9 | 130.8 |

**Toxicity quotient calculations - based on Average of incremental samples**

| Analyte | EPC - Avg (mg/kg) | Koc | LogKow | Invert Conc (mg/kg) | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NOAEL | LOAEL | NOAEL | LOAEL |
| 2,3,7,8-TCDF | 0.0000223 | 2.82E+05 | 7.92 | 0.0038 | 7.96E-04 | 1.40E-04 | 1.40E-03 | 5.7 | 0.6 |
| 2,3,7,8-TCDD | 0.00000511 | 2.82E+05 | 7.92 | 0.0009 | 1.82E-04 | 1.40E-05 | 1.40E-04 | 13.0 | 1.3 |
| 1,2,3,7,8-PeCDF | 0.0000265 | 3.12E+05 | 8.20 | 0.0072 | 1.50E-03 | 9.80E-04 | 9.80E-03 | 1.5 | 0.2 |
| 2,3,4,7,8-PeCDF | 0.000724133 | 2.82E+05 | 7.92 | 0.1247 | 2.58E-02 | 9.80E-05 | 9.80E-04 | 263.6 | 26.4 |
| 1,2,3,7,8-PeCDD | 0.0000579 | 2.82E+05 | 7.92 | 0.0100 | 2.07E-03 | 1.40E-05 | 1.40E-04 | 147.6 | 14.8 |
| 1,2,3,4,7,8-HxCDF | 0.0001177 | 1.83E+05 | 7.58 | 0.0158 | 3.28E-03 | 1.40E-04 | 1.40E-03 | 23.4 | 2.3 |
| 1,2,3,6,7,8-HxCDF | 0.000134767 | 2.82E+05 | 7.92 | 0.0232 | 4.81E-03 | 1.40E-04 | 1.40E-03 | 34.3 | 3.4 |
| 2,3,4,6,7,8-HxCDF | 0.0003134 | 2.42E+05 | 7.80 | 0.0494 | 1.02E-02 | 1.40E-04 | 1.40E-03 | 73.2 | 7.3 |
| 1,2,3,7,8,9-HxCDF | Not Detected | 4.08E+05 | 8.21 | Not Applicable | | | | | |
| 1,2,3,4,7,8-HxCDD | 3.90667E-05 | 4.08E+05 | 8.21 | 0.0083 | 1.72E-03 | 1.40E-04 | 1.40E-03 | 12.3 | 1.2 |
| 1,2,3,6,7,8-HxCDD | 0.000353 | 6.69E+04 | 6.92 | 0.0346 | 7.17E-03 | 1.40E-04 | 1.40E-03 | 51.2 | 5.1 |
| 1,2,3,7,8,9-HxCDD | 0.0001734 | 6.69E+04 | 6.92 | 0.0170 | 3.52E-03 | 1.40E-04 | 1.40E-03 | 25.2 | 2.5 |
| 1,2,3,4,6,7,8-HpCDF | 0.000357 | 5.52E+04 | 6.64 | 0.0242 | 5.01E-03 | 1.40E-03 | 1.40E-02 | 3.6 | 0.4 |
| 1,2,3,4,7,8,9-HpCDF | 0.0000394 | 4.80E+04 | 6.53 | 0.0025 | 5.11E-04 | 1.40E-03 | 1.40E-02 | 0.4 | 0.0 |
| 1,2,3,4,6,7,8-HpCDD | 0.002413333 | 6.77E+04 | 6.80 | 0.1835 | 3.81E-02 | 1.40E-03 | 1.40E-02 | 27.2 | 2.7 |
| OCDF | 0.000335667 | 6.71E+05 | 8.60 | 0.0949 | 1.97E-02 | 9.80E-02 | 9.80E-01 | 0.2 | 0.0 |
| OCDD | 0.0157 | 4.03E+05 | 8.20 | 3.3158 | 6.87E-01 | 9.80E-02 | 9.80E-01 | 7.0 | 0.7 |
| Dioxin/Furan TEQ | Sum of congener TQs | | | | | | | 689.4 | 68.9 |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-8 Exposure Calculation and Comparison to EBVs for Red-tailed Hawk - Mercury, All Exposure Units

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Red-tailed Hawk **AUF:** EU-specific

**Toxicity quotient calculations**

| Analyte | Exposure Unit | EPC | | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|
| | | (mg/kg) | Basis | | | NOAEL | LOAEL | NOAEL | LOAEL |
| Mercury (elemental) | West Parcel Upland EU | NA | 90UCL - Composite samples | NA | NA | 0.45 | 0.9 | NA | NA |
| | | nc | 90UCL - Discrete samples | NA | NA | | | NA | NA |
| | | 3.5 | MDC | 0.003 | 0.00009 | | | 0.0002 | 0.0001 |
| | Central Parcel Upland EU | 3.23 | 90UCL - Composite samples | 0.006 | 0.0002 | | | 0.00038 | 0.00019 |
| | | 3.84 | 90UCL - Discrete samples | 0.006 | 0.0002 | | | 0.00045 | 0.00023 |
| | East Parcel Upland EU | 0.116 | 90UCL - Composite samples | 0.004 | 0.000004 | | | 0.00001 | 0.000005 |
| | | 0.222 | 90UCL - Discrete samples | 0.004 | 0.000008 | | | 0.00002 | 0.00001 |
| | Central Beach EU | nc | 90UCL - Composite samples | NA | NA | | | NA | NA |
| | | nc | 90UCL - Discrete samples | NA | NA | | | NA | NA |
| | | 1.18 | MDC | 0.0002 | 0.000002 | | | 0.000005 | 0.000002 |
| | Inner Cove Beach EU | nc | 90UCL - Composite samples | NA | NA | | | NA | NA |
| | | 26.04 | 90UCL - Discrete samples | 0.0008 | 0.000183 | | | 0.0004 | 0.0002 |

Notes:
AUF = Area Use Factor
Ce = concentration in earthworm
Cm = concentration in small mammals
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
mg/kg dw = milligram per kilogram dry weight
NA = Not Applicable
nc = not calculated; 90UCL was not calculated if there were too few samples for proUCL to calculate a 90UCL.
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.
90UCL calculations provided where available; if not able to calculate, then MDC is provided.

## TABLE 4-9 Exposure Calculation and Comparison to EBVs for Red-tailed Hawk - Aroclors, All Exposure Units

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Red-tailed hawk

**AUF:** EU-specific

**Toxicity quotient calculations**

| Analyte | Exposure Unit | EPC | | Koc (L/kg) | LogKow | Ce (mg/kg dw) | Cm (mg/kg dw) | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (mg/kg) | Basis | | | | | | | NOAEL | LOAEL | NOAEL | LOAEL |
| Total Aroclors | West Parcel Upland EU | NA | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | nc | 90UCL - Discrete samples | NA | | Not Applicable | | | | | | | |
| | | 0.111 | MDC | NA | | 0.2 | 0.2 | 0.003 | 0.00002 | 0.29 | 0.58 | 0.0001 | 0.00004 |
| | Central Parcel Upland EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 0.163 | 90UCL - Discrete samples | NA | | 0.3 | 0.3 | 0.006 | 0.0001 | 0.29 | 0.58 | 0.0003 | 0.0001 |
| | East Parcel Upland EU | 5.22 | 90UCL - Composite samples | NA | | 38.8 | 38.8 | 0.004 | 0.0055 | 0.29 | 0.58 | 0.019 | 0.010 |
| | | 0.445 | 90UCL - Discrete samples | NA | | 1.4 | 1.4 | 0.004 | 0.0002 | 0.29 | 0.58 | 0.001 | 0.0003 |
| | Central Beach EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | Inner Cove Beach EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 168.2 | 90UCL - Discrete samples | NA | | 4382.3 | 4382.3 | 0.0008 | 0.12 | 0.29 | 0.58 | 0.4 | 0.2 |
| Aroclor 1254 | West Parcel Upland EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | Central Parcel Upland EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | East Parcel Upland EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 0.0208 | 90UCL - Discrete samples | 130500 | 6.5 | 0.5 | 0.5 | 0.004 | 0.000 | 0.29 | 0.58 | 0.0002 | 0.0001 |
| | Central Beach EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | Inner Cove Beach EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 168.2 | 90UCL - Discrete samples | 130500 | 6.5 | 3640.0 | 3640.0 | 0.0008 | 0.10 | 0.29 | 0.58 | 0.4 | 0.2 |
| Aroclor 1260 | West Parcel Upland EU | NA | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | nc | 90UCL - Discrete samples | NA | | Not Applicable | | | | | | | |
| | | 0.111 | MDC | 349700 | 7.55 | 7.3 | 7.3 | 0.003 | 0.00078 | 0.29 | 0.58 | 0.003 | 0.001 |
| | Central Parcel Upland EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 0.159 | 90UCL - Discrete samples | 349700 | 7.55 | 10.5 | 10.5 | 0.006 | 0.00223 | 0.29 | 0.58 | 0.01 | 0.004 |
| | East Parcel Upland EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 0.441 | 90UCL - Discrete samples | 349700 | 7.55 | 29.2 | 29.2 | 0.004 | 0.00412 | 0.29 | 0.58 | 0.01 | 0.01 |
| | Central Beach EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | Inner Cove Beach EU | Not Detected | | NA | | Not Applicable | | | | | | | |

Notes:
AUF = Area Use Factor
Ce = concentration in earthworm
Cm = concentration in small mammals
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
mg/kg dw = milligram per kilogram dry weight
NA = Not Applicable
nc = not calculated; 90UCL was not calculated if there were too few samples for proUCL to calculate a 90UCL.
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.
90UCL calculations provided where available; if not able to calculate, then MDC is provided.

# TABLE 4-10 Exposure Calculation and Comparison to EBVs for Red-tailed Hawk - Pesticides, All Exposure Units

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Red-tailed Hawk **AUF:** EU-specific

**Toxicity quotient calculations**

| Analyte | Exposure Unit | EPC | | Koc (L/kg) | LogKow | Ce (mg/kg dw) | Cm (mg/kg dw) | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (mg/kg) | Basis | | | | | | | NOAEL | LOAEL | NOAEL | LOAEL |
| Total of 4,4'-DDD, -DDE, -DDT | Central Beach EU | 0.00123 | MDC | NA | NA | 0.0138 | 0.1 | 0.0002 | 4.70E-07 | 2.27E-01 | 2.27E+00 | 2.07E-06 | 2.07E-07 |
| | East Parcel Upland EU | 0.0571 | MDC | NA | NA | 0.6395 | 3.1 | 0.004 | 4.37E-04 | 2.27E-01 | 2.27E+00 | 1.92E-03 | 1.92E-04 |
| Total of 2,4' and 4,4'-DDD, -DDE, -DDT | Central Beach EU | 0.0016 | MDC | NA | NA | 0.0179 | 0.1 | 0.0002 | 6.12E-07 | 2.27E-01 | 2.27E+00 | 2.69E-06 | 2.69E-07 |
| beta-Endosulfan | Central Beach EU | 0.000726 | MDC | 6761.0 | 3.5 | 0.00074 | 0.0007 | 0.0002 | 5.55E-09 | 1.00E+01 | NA | 5.55E-10 | NA |
| beta-Hexachlorocyclohexane | Central Beach EU | 0.000831 | MDC | 2807.0 | 4.3 | 0.00941 | 0.0094 | 0.0002 | 6.67E-08 | 5.60E-01 | 2.25E+00 | 1.19E-07 | 2.97E-08 |
| Endrin | Central Beach EU | 0.000751 | MDC | 20090.0 | 5.5 | 0.01288 | 0.0129 | 0.0002 | 9.13E-08 | 1.00E-02 | 1.00E-01 | 9.13E-06 | 9.13E-07 |
| Total Endosulfan | Central Beach EU | 0.000726 | MDC | 6761.0 | 3.5 | 0.00074 | 0.0007 | 0.0002 | 5.55E-09 | 1.00E+01 | NA | 5.55E-10 | NA |

Notes:

Only MDCs are provided because there were too few data to calculate 90UCLs.

AUF = Area Use Factor

Ce = concentration in earthworm

Cm = concentration in small mammals

CPEC - Chemical of Potential Ecological Concern

EPC = Exposure Point Concentration

EBV = Exposure Benchmark Value

EU = Exposure Unit

MDC = Maximum Detected Concentration

mg/kg dw = milligram per kilogram dry weight

NA = Not Applicable

TQ - Toxicity Quotient

90UCL = 90th upper confidence limit on the mean

Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-11 Exposure Calculation and Comparison to EBVs for Red-tailed Hawk - Dioxins/Furans, Wharf Road Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Red-tailed Hawk **AUF:** EU-specific (Wharf Road EU)

**Toxicity quotient calculations - based on MDC of incremental samples**

| Analyte | EPC-MDC (mg/kg) | Koc | LogKow | Ce | Cm | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) NOAEL | EBV (mg/kg BW/day) LOAEL | Toxicity Quotient (TQ) NOAEL | Toxicity Quotient (TQ) LOAEL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,3,7,8-TCDF | 3.73E-05 | 282000 | 7.92 | NA | 0.000005 | 0.0002 | 4.80E-11 | 1.40E-04 | 1.40E-03 | 3.43E-07 | 3.43E-08 |
| 2,3,7,8-TCDD | 6.45E-06 | 282000 | 7.92 | NA | 0.000005 | 0.0002 | 3.63E-11 | 1.40E-05 | 1.40E-04 | 2.59E-06 | 2.59E-07 |
| 1,2,3,7,8-PeCDF | 4.56E-05 | 312300 | 8.20 | 0.012 | 0.012 | 0.0002 | 8.77E-08 | 9.80E-04 | 9.80E-03 | 8.95E-05 | 8.95E-06 |
| 2,3,4,7,8-PeCDF | 1.59E-03 | 282000 | 7.92 | 0.274 | 0.274 | 0.0002 | 1.93E-06 | 9.80E-05 | 9.80E-04 | 1.97E-02 | 1.97E-03 |
| 1,2,3,7,8-PeCDD | 8.48E-05 | 282000 | 7.92 | 0.015 | 0.015 | 0.0002 | 1.03E-07 | 1.40E-05 | 1.40E-04 | 7.37E-03 | 7.37E-04 |
| 1,2,3,4,7,8-HxCDF | 2.55E-04 | 182900 | 7.58 | 0.034 | 0.034 | 0.0002 | 2.42E-07 | 1.40E-04 | 1.40E-03 | 1.73E-03 | 1.73E-04 |
| 1,2,3,6,7,8-HxCDF | 2.80E-04 | 282000 | 7.92 | 0.048 | 0.048 | 0.0002 | 3.41E-07 | 1.40E-04 | 1.40E-03 | 2.43E-03 | 2.43E-04 |
| 2,3,4,6,7,8-HxCDF | 6.52E-04 | 242100 | 7.80 | 0.103 | 0.103 | 0.0002 | 7.26E-07 | 1.40E-04 | 1.40E-03 | 5.19E-03 | 5.19E-04 |
| 1,2,3,4,7,8-HxCDD | 5.30E-05 | 408000 | 8.21 | 0.011 | 0.011 | 0.0002 | 7.96E-08 | 1.40E-03 | 1.40E-04 | 1.40E-03 | 5.69E-04 |
| 1,2,3,6,7,8-HxCDD | 6.59E-04 | 66870 | 6.92 | 0.065 | 0.065 | 0.0002 | 4.56E-07 | 1.40E-03 | 1.40E-04 | 1.40E-03 | 3.26E-03 |
| 1,2,3,7,8,9-HxCDD | 3.33E-04 | 66870 | 6.92 | 0.033 | 0.033 | 0.0002 | 2.30E-07 | 1.40E-03 | 1.40E-04 | 1.40E-03 | 1.65E-03 |
| 1,2,3,4,6,7,8-HpCDF | 4.49E-04 | 55240 | 6.64 | 0.030 | 0.030 | 0.0002 | 2.15E-07 | 1.40E-02 | 1.40E-03 | 1.40E-02 | 1.53E-04 |
| 1,2,3,4,7,8,9-HpCDF | 7.38E-05 | 48020 | 6.53 | 0.005 | 0.005 | 0.0002 | 3.26E-08 | 1.40E-02 | 1.40E-03 | 1.40E-02 | 2.33E-05 |
| 1,2,3,4,6,7,8-HpCDD | 3.16E-03 | 67730 | 6.80 | 0.240 | 0.240 | 0.0002 | 1.70E-06 | 1.40E-02 | 1.40E-03 | 1.40E-02 | 1.21E-03 |
| OCDF | 3.66E-04 | 670500 | 8.60 | 0.104 | 0.104 | 0.0002 | 7.31E-07 | 9.80E-02 | 9.80E-01 | 9.80E-01 | 7.46E-07 |
| OCDD | 1.88E-02 | 402900 | 8.20 | 3.970 | 3.970 | 0.0002 | 2.80E-05 | 9.80E-02 | 9.80E-01 | 9.80E-01 | 2.86E-05 |
| Dioxin/Furan TEQ | | | | | | | | | Sum of congener TQs | 2.04E+00 | 1.05E-02 |

**Toxicity quotient calculations - based on Average of incremental samples**

| Analyte | EPC-Avg (mg/kg) | Koc (L/kg) | LogKow | Ce (mg/kg dw) | Cm (mg/kg dw) | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) NOAEL | EBV (mg/kg BW/day) LOAEL | Toxicity Quotient (TQ) NOAEL | Toxicity Quotient (TQ) LOAEL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,3,7,8-TCDF | 2.23E-05 | 282000 | 7.92 | NA | 0.000003 | 0.0002 | 2.87E-11 | 1.40E-04 | 1.40E-03 | 2.05E-07 | 2.05E-08 |
| 2,3,7,8-TCDD | 5.11E-06 | 282000 | 7.92 | NA | 0.000004 | 0.0002 | 2.82E-11 | 1.40E-05 | 1.40E-04 | 2.01E-06 | 2.01E-07 |
| 1,2,3,7,8-PeCDF | 2.65E-05 | 312300 | 8.20 | 0.007 | 0.007 | 0.0002 | 5.10E-08 | 9.80E-04 | 9.80E-03 | 5.20E-05 | 5.20E-06 |
| 2,3,4,7,8-PeCDF | 7.24E-04 | 282000 | 7.92 | 0.125 | 0.125 | 0.0002 | 8.81E-07 | 9.80E-05 | 9.80E-04 | 8.99E-03 | 8.99E-04 |
| 1,2,3,7,8-PeCDD | 5.79E-05 | 282000 | 7.92 | 0.010 | 0.010 | 0.0002 | 7.04E-08 | 1.40E-05 | 1.40E-04 | 5.03E-03 | 5.03E-04 |
| 1,2,3,4,7,8-HxCDF | 1.18E-04 | 182900 | 7.58 | 0.016 | 0.016 | 0.0002 | 1.12E-07 | 1.40E-04 | 1.40E-03 | 7.98E-04 | 7.98E-05 |
| 1,2,3,6,7,8-HxCDF | 1.35E-04 | 282000 | 7.92 | 0.023 | 0.023 | 0.0002 | 1.64E-07 | 1.40E-04 | 1.40E-03 | 1.17E-03 | 1.17E-04 |
| 2,3,4,6,7,8-HxCDF | 3.13E-04 | 242100 | 7.80 | 0.049 | 0.049 | 0.0002 | 3.49E-07 | 1.40E-04 | 1.40E-03 | 2.49E-03 | 2.49E-04 |
| 1,2,3,4,7,8-HxCDD | 3.91E-05 | 408000 | 8.21 | 0.008 | 0.008 | 0.0002 | 5.87E-08 | 1.40E-03 | 1.40E-04 | 1.40E-03 | 4.19E-04 |
| 1,2,3,6,7,8-HxCDD | 3.53E-04 | 66870 | 6.92 | 0.035 | 0.035 | 0.0002 | 2.44E-07 | 1.40E-03 | 1.40E-04 | 1.40E-03 | 1.74E-03 |
| 1,2,3,7,8,9-HxCDD | 1.73E-04 | 66870 | 6.92 | 0.017 | 0.017 | 0.0002 | 1.20E-07 | 1.40E-03 | 1.40E-04 | 1.40E-03 | 8.57E-04 |
| 1,2,3,4,6,7,8-HpCDF | 3.57E-04 | 55240 | 6.64 | 0.024 | 0.024 | 0.0002 | 1.71E-07 | 1.40E-02 | 1.40E-03 | 1.40E-02 | 1.22E-04 |
| 1,2,3,4,7,8,9-HpCDF | 3.94E-05 | 48020 | 6.53 | 0.002 | 0.002 | 0.0002 | 1.74E-08 | 1.40E-02 | 1.40E-03 | 1.40E-02 | 1.24E-05 |
| 1,2,3,4,6,7,8-HpCDD | 2.41E-03 | 67730 | 6.80 | 0.184 | 0.184 | 0.0002 | 1.30E-06 | 1.40E-02 | 1.40E-03 | 1.40E-02 | 9.26E-04 |
| OCDF | 3.36E-04 | 670500 | 8.60 | 0.095 | 0.095 | 0.0002 | 6.70E-07 | 9.80E-02 | 9.80E-01 | 9.80E-01 | 6.84E-07 |
| OCDD | 1.57E-02 | 402900 | 8.20 | 3.316 | 3.316 | 0.0002 | 2.34E-05 | 9.80E-02 | 9.80E-01 | 9.80E-01 | 2.39E-05 |
| Dioxin/Furan TEQ | | | | | | | | | Sum of congener TQs | 2.02E+00 | 5.96E-03 |

Notes:
AUF = Area Use Factor
Ce = concentration in earthworm
Cm = concentration in small mammals
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
mg/kg dw = milligram per kilogram dry weight
NA = Not Applicable
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

## TABLE 4-12  Exposure Calculation and Comparison to EBVs for Short-tailed Shrew - West Parcel Upland Exposure Unit

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Short-tailed Shrew (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| No CPECs | NA | NA | NA | NA | NA | NA | NA | NA |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
NA = Not Applicable
TQ - Toxicity Quotient
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-13 Exposure Calculation and Comparison to EBVs for Short-tailed Shrew - Central Parcel Upland Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Short-tailed Shrew (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| Antimony | 2.78 | 90UCL - Composite samples | 0.60 | 0.32 | 0.059 | NOAEL | 10.1 | 5.4 |
| | | | | | 0.59 | LOAEL | 1.0 | 0.5 |
| | 7.4 | 90UCL - Discrete samples | 1.60 | 0.85 | 0.059 | NOAEL | 27.1 | 14.4 |
| | | | | | 0.59 | LOAEL | 2.7 | 1.4 |
| | 0.56 | Background Concentration | 0.12 | 0.06 | 0.059 | NOAEL | 2.0 | 1.1 |
| | | | | | 0.59 | LOAEL | 0.2 | 0.1 |
| Copper | 1400.0 | 90UCL - Composite samples | 159.47 | 87.66 | 5.6 | NOAEL | 28.5 | 15.7 |
| | | | | | 9.34 | LOAEL | 17.1 | 9.4 |
| | | | | | 25 | NOAEL | 6.4 | 3.5 |
| | | | | | 45.7 | LOAEL | 3.5 | 1.9 |
| | 621.1 | 90UCL - Discrete samples | 70.75 | 39.89 | 5.6 | NOAEL | 12.6 | 7.1 |
| | | | | | 9.34 | LOAEL | 7.6 | 4.3 |
| | | | | | 25 | NOAEL | 2.8 | 1.6 |
| | | | | | 45.7 | LOAEL | 1.5 | 0.9 |
| | 34 | Background Concentration | 3.87 | 2.86 | 5.6 | NOAEL | 0.7 | 0.5 |
| | | | | | 9.34 | LOAEL | 0.4 | 0.3 |
| | | | | | 25 | NOAEL | 0.2 | 0.1 |
| | | | | | 45.7 | LOAEL | 0.1 | 0.1 |
| Lead | 628.1 | 90UCL - Composite samples | 34.38 | 20.19 | 4.7 | NOAEL | 7.3 | 4.3 |
| | | | | | 8.9 | LOAEL | 3.9 | 2.3 |
| | 632.1 | 90UCL - Discrete samples | 34.56 | 20.29 | 4.7 | NOAEL | 7.4 | 4.3 |
| | | | | | 8.9 | LOAEL | 3.9 | 2.3 |
| | 79 | Background Concentration | 6.21 | 3.67 | 4.7 | NOAEL | 1.3 | 0.8 |
| | | | | | 8.9 | LOAEL | 0.7 | 0.4 |
| Zinc | 564.9 | 90UCL - Composite samples | 146.42 | 91.88 | 75.4 | NOAEL | 1.9 | 1.2 |
| | | | | | 103.0 | LOAEL | 1.4 | 0.9 |
| | 408.7 | 90UCL - Discrete samples | 131.05 | 80.93 | 75.4 | NOAEL | 1.7 | 1.1 |
| | | | | | 103.0 | LOAEL | 1.3 | 0.8 |
| | 180 | Background Concentration | 99.32 | 59.19 | 75.4 | NOAEL | 1.3 | 0.8 |
| | | | | | 103.0 | LOAEL | 1.0 | 0.6 |
| HPAH | 12.65 | 90UCL - Composite samples | 6.95 | 3.73 | 0.615 | NOAEL | 11.3 | 6.1 |
| | | | | | 3.07 | LOAEL | 2.3 | 1.2 |
| | 56.85 | 90UCL - Discrete samples | 31.25 | 16.68 | 0.615 | NOAEL | 50.8 | 27.1 |
| | | | | | 3.07 | LOAEL | 10.2 | 5.4 |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
HPAHs - High molecular weight polyaromatic hydrocarbons
Refer to Section 3 tables for all exposure parameters, EBVs, and equations

# TABLE 4-14 Exposure Calculation and Comparison to EBVs for Short-tailed Shrew - East Parcel Upland Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Short-tailed Shrew (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC* | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| Antimony | 11.94 | 90UCL - Composite samples | 2.57 | 1.36 | 0.059 | NOAEL | 43.6 | 23.1 |
| | | | | | 0.59 | LOAEL | 4.4 | 2.3 |
| | 71.4 | 90UCL - Discrete samples | 15.37 | 8.13 | 0.059 | NOAEL | 260.5 | 137.9 |
| | | | | | 0.59 | LOAEL | 26.0 | 13.8 |
| | 0.56 | Background Concentration | 0.12 | 0.06 | 0.059 | NOAEL | 2.0 | 1.1 |
| | | | | | 0.59 | LOAEL | 0.2 | 0.1 |
| Copper | 7795.0 | 90UCL - Composite samples | 887.89 | 475.34 | 5.6 | NOAEL | 158.6 | 84.9 |
| | | | | | 9.34 | LOAEL | 95.1 | 50.9 |
| | | | | | 25 | NOAEL | 35.5 | 19.0 |
| | | | | | 45.7 | LOAEL | 19.4 | 10.4 |
| | 10637.0 | 90UCL - Discrete samples | 1211.61 | 647.02 | 5.6 | NOAEL | 216.4 | 115.5 |
| | | | | | 9.34 | LOAEL | 129.7 | 69.3 |
| | | | | | 25 | NOAEL | 48.5 | 25.9 |
| | | | | | 45.7 | LOAEL | 26.5 | 14.2 |
| | 34 | Background Concentration | 3.87 | 2.86 | 5.6 | NOAEL | 0.7 | 0.5 |
| | | | | | 9.34 | LOAEL | 0.4 | 0.3 |
| | | | | | 25 | NOAEL | 0.2 | 0.1 |
| | | | | | 45.7 | LOAEL | 0.1 | 0.1 |
| Lead | 779.7 | 90UCL - Composite samples | 41.13 | 24.17 | 4.7 | NOAEL | 8.8 | 5.1 |
| | | | | | 8.9 | LOAEL | 4.6 | 2.7 |
| | 701.5 | 90UCL - Discrete samples | 37.68 | 22.13 | 4.7 | NOAEL | 8.0 | 4.7 |
| | | | | | 8.9 | LOAEL | 4.2 | 2.5 |
| | 79 | Background Concentration | 6.21 | 3.67 | 4.7 | NOAEL | 1.3 | 0.8 |
| | | | | | 8.9 | LOAEL | 0.7 | 0.4 |
| Aroclors | 5.22 | 90UCL - Composite samples | 8.15 | 4.17 | 0.0037 | NOAEL | 2201.9 | 1126.0 |
| | | | | | 0.037 | LOAEL | 220.2 | 112.6 |
| | 0.445 | 90UCL - Discrete samples | 0.29 | 0.15 | 0.0037 | NOAEL | 77.6 | 40.9 |
| | | | | | 0.037 | LOAEL | 7.8 | 4.1 |
| Zinc | 431.7 | 90UCL - Composite samples | 133.52 | 82.67 | 75.4 | NOAEL | 1.8 | 1.1 |
| | | | | | 103.0 | LOAEL | 1.3 | 0.8 |
| | 630.1 | 90UCL - Discrete samples | 152.04 | 95.94 | 75.4 | NOAEL | 2.0 | 1.3 |
| | | | | | 103.0 | LOAEL | 1.5 | 0.9 |
| | 180 | Background Concentration | 99.32 | 59.19 | 75.4 | NOAEL | 1.3 | 0.8 |
| | | | | | 103.0 | LOAEL | 1.0 | 0.6 |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
nc = not calculated; 90UCL was not calculated if there were too few samples for proUCL to calculate a 90UCL
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean

# TABLE 4-15 Exposure Calculation and Comparison to EBVs for Short-tailed Shrew - Inner Cove Beach Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Short-tailed Shrew (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC* | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| Antimony | NA | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 62.6 | 90UCL - Discrete samples | 13.47 | 7.13 | 0.059 | NOAEL | 228.3 | 120.9 |
| | | | | | 0.59 | LOAEL | 22.8 | 12.1 |
| | 0.56 | Background Concentration | 0.12 | 0.06 | 0.059 | NOAEL | 2.0 | 1.1 |
| | | | | | 0.59 | LOAEL | 0.2 | 0.1 |
| Copper | NA | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 744.3 | 90UCL - Discrete samples | 84.78 | 47.48 | 5.6 | NOAEL | 15.1 | 8.5 |
| | | | | | 9.34 | LOAEL | 9.1 | 5.1 |
| | | | | | 25 | NOAEL | 3.4 | 1.9 |
| | | | | | 45.7 | LOAEL | 1.9 | 1.0 |
| | 34 | Background Concentration | 3.87 | 2.86 | 5.6 | NOAEL | 0.7 | 0.5 |
| | | | | | 9.34 | LOAEL | 0.4 | 0.3 |
| | | | | | 25 | NOAEL | 0.2 | 0.1 |
| | | | | | 45.7 | LOAEL | 0.1 | 0.1 |
| Lead | NA | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 4115.0 | 90UCL - Discrete samples | 164.56 | 98.13 | 4.7 | NOAEL | 35.0 | 20.9 |
| | | | | | 8.9 | LOAEL | 18.5 | 11.0 |
| | 79 | Background Concentration | 6.21 | 3.67 | 4.7 | NOAEL | 1.3 | 0.8 |
| | | | | | 8.9 | LOAEL | 0.7 | 0.4 |
| Aroclors | NA | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 168.2 | 90UCL - Discrete samples | 916.96 | 461.47 | 0.0037 | NOAEL | 247827.1 | 124721.1 |
| | | | | | 0.037 | LOAEL | 24782.7 | 12472.1 |
| HPAHs | NA | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 10.7 | 90UCL - Discrete samples | 5.90 | 3.17 | 0.615 | NOAEL | 9.6 | 5.1 |
| | | | | | 3.07 | LOAEL | 1.9 | 1.0 |
| Zinc | NA | 90UCL - Composite samples | NA | NA | NA | NA | NA | NA |
| | 480.6 | 90UCL - Discrete samples | 138.52 | 86.21 | 75.4 | NOAEL | 1.8 | 1.1 |
| | | | | | 103.0 | LOAEL | 1.3 | 0.8 |
| | 180 | Background Concentration | 99.32 | 59.19 | 75.4 | NOAEL | 1.3 | 0.8 |
| | | | | | 103.0 | LOAEL | 1.0 | 0.6 |

Notes:
* Diesel range hydrocarbons and dibenzofuran not evaluated in this Level II expanded assessment.
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
nc = not calculated; 90UCL was not calculated if there were too few samples for proUCL to calculate a 90UCL
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
HPAHs - High molecular weight polyaromatic hydrocarbons
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-16 Exposure Calculation and Comparison to EBVs for Short-tailed Shrew - Central Beach Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

## Modeled Receptor: Short-tailed Shrew (insectivorous and omnivorous diets)

**Toxicity quotient calculations**

| CPEC | EPC | | Exposure Estimate (mg/kg BW/ day) | | EBV | Type of EBV | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | Basis | Insectivore | Omnivore | (mg/kg BW/ day) | | Insectivore | Omnivore |
| Cadmium | NA | 90UCL | NA | NA | NA | NA | NA | NA |
| | 17 | MDC | 16.57 | 8.64 | 0.77 | NOAEL | 21.5 | 11.2 |
| | | | | | 1 | NOAEL | 16.6 | 8.6 |
| | | | | | 7.7 | LOAEL | 2.2 | 1.1 |
| | | | | | 10 | LOAEL | 1.7 | 0.9 |
| | 0.63 | Background Concentration | 1.20 | 0.65 | 0.77 | NOAEL | 1.6 | 0.8 |
| | | | | | 1 | NOAEL | 1.2 | 0.7 |
| | | | | | 7.7 | LOAEL | 0.2 | 0.1 |
| | | | | | 10 | LOAEL | 0.1 | 0.1 |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-17 Exposure Calculation and Comparison to EBVs for Short-tailed Shrew - Wharf Road Exposure Unit (Dioxins/Furans Only)

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Short-tailed Shrew (insectivorous and omnivorous diets)

**Toxicity quotient calculations - based on MDC of incremental samples**

| Analyte | EPC - MDC (mg/kg) | Koc | LogKow | Estimated Invert Conc (mg/kg) | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NOAEL | LOAEL | NOAEL | LOAEL |
| 2,3,7,8-TCDF | 0.0000373 | 2.82E+05 | 7.92 | 0.006 | 1.34E-03 | 2.20E-06 | 2.20E-05 | 610.3 | 61.0 |
| 2,3,7,8-TCDD | 0.00000645 | 2.82E+05 | 7.92 | 0.001 | 2.32E-04 | 2.20E-07 | 2.20E-06 | 1055.3 | 105.5 |
| 1,2,3,7,8-PeCDF | 0.0000456 | 3.12E+05 | 8.20 | 0.012 | 2.60E-03 | 1.54E-05 | 1.54E-04 | 168.6 | 16.9 |
| 2,3,4,7,8-PeCDF | 0.00159 | 2.82E+05 | 7.92 | 0.274 | 5.72E-02 | 1.54E-06 | 1.54E-05 | 37164.6 | 3716.5 |
| 1,2,3,7,8-PeCDD | 0.0000848 | 2.82E+05 | 7.92 | 0.015 | 3.05E-03 | 2.20E-07 | 2.20E-06 | 13874.8 | 1387.5 |
| 1,2,3,4,7,8-HxCDF | 0.000255 | 1.83E+05 | 7.58 | 0.034 | 7.16E-03 | 2.20E-06 | 2.20E-05 | 3255.6 | 325.6 |
| 1,2,3,6,7,8-HxCDF | 0.00028 | 2.82E+05 | 7.92 | 0.048 | 1.01E-02 | 2.20E-06 | 2.20E-05 | 4581.3 | 458.1 |
| 2,3,4,6,7,8-HxCDF | 0.000652 | 2.42E+05 | 7.80 | 0.103 | 2.15E-02 | 2.20E-06 | 2.20E-05 | 9771.0 | 977.1 |
| 1,2,3,7,8,9-HxCDF | Not Detected | 4.08E+05 | 8.21 | Not Applicable | | | | | |
| 1,2,3,4,7,8-HxCDD | 0.000053 | 4.08E+05 | 8.21 | 0.011 | 2.36E-03 | 2.20E-06 | 2.20E-05 | 1071.5 | 107.1 |
| 1,2,3,6,7,8-HxCDD | 0.000659 | 6.69E+04 | 6.92 | 0.065 | 1.35E-02 | 2.20E-06 | 2.20E-05 | 6134.7 | 613.5 |
| 1,2,3,7,8,9-HxCDD | 0.000333 | 6.69E+04 | 6.92 | 0.033 | 6.82E-03 | 2.20E-06 | 2.20E-05 | 3099.9 | 310.0 |
| 1,2,3,4,6,7,8-HpCDF | 0.000449 | 5.52E+04 | 6.64 | 0.030 | 6.35E-03 | 2.20E-05 | 2.20E-04 | 288.8 | 28.9 |
| 1,2,3,4,7,8,9-HpCDF | 0.0000738 | 4.80E+04 | 6.53 | 0.005 | 9.64E-04 | 2.20E-05 | 2.20E-04 | 43.8 | 4.4 |
| 1,2,3,4,6,7,8-HpCDD | 0.00316 | 6.77E+04 | 6.80 | 0.240 | 5.02E-02 | 2.20E-05 | 2.20E-04 | 2283.9 | 228.4 |
| OCDF | 0.000366 | 6.71E+05 | 8.60 | 0.104 | 2.16E-02 | 1.54E-03 | 1.54E-02 | 14.0 | 1.4 |
| OCDD | 0.0188 | 4.03E+05 | 8.20 | 3.970 | 8.30E-01 | 1.54E-03 | 1.54E-02 | 538.9 | 53.9 |
| Dioxin/Furan TEQ | Sum of congener TQs | | | | | | | 83957.0 | 8395.7 |

**Toxicity quotient calculations - based on Average of incremental samples**

| Analyte | EPC - Avg (mg/kg) | Koc | LogKow | Invert Conc (mg/kg) | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NOAEL | LOAEL | NOAEL | LOAEL |
| 2,3,7,8-TCDF | 0.0000223 | 2.82E+05 | 7.92 | 0.0038 | 8.03E-04 | 2.20E-06 | 2.20E-05 | 364.9 | 36.5 |
| 2,3,7,8-TCDD | 0.00000511 | 2.82E+05 | 7.92 | 0.0009 | 1.84E-04 | 2.20E-07 | 2.20E-06 | 836.1 | 83.6 |
| 1,2,3,7,8-PeCDF | 0.0000265 | 3.12E+05 | 8.20 | 0.0072 | 1.51E-03 | 1.54E-05 | 1.54E-04 | 98.0 | 9.8 |
| 2,3,4,7,8-PeCDF | 0.000724133 | 2.82E+05 | 7.92 | 0.1247 | 2.61E-02 | 1.54E-06 | 1.54E-05 | 16925.9 | 1692.6 |
| 1,2,3,7,8-PeCDD | 0.0000579 | 2.82E+05 | 7.92 | 0.0100 | 2.08E-03 | 2.20E-07 | 2.20E-06 | 9473.5 | 947.3 |
| 1,2,3,4,7,8-HxCDF | 0.0001177 | 1.83E+05 | 7.58 | 0.0158 | 3.31E-03 | 2.20E-06 | 2.20E-05 | 1502.7 | 150.3 |
| 1,2,3,6,7,8-HxCDF | 0.000134767 | 2.82E+05 | 7.92 | 0.0232 | 4.85E-03 | 2.20E-06 | 2.20E-05 | 2205.0 | 220.5 |
| 2,3,4,6,7,8-HxCDF | 0.0003134 | 2.42E+05 | 7.80 | 0.0494 | 1.03E-02 | 2.20E-06 | 2.20E-05 | 4696.7 | 469.7 |
| 1,2,3,7,8,9-HxCDF | Not Detected | 4.08E+05 | 8.21 | Not Applicable | | | | | |
| 1,2,3,4,7,8-HxCDD | 3.90667E-05 | 4.08E+05 | 8.21 | 0.0083 | 1.74E-03 | 2.20E-06 | 2.20E-05 | 789.8 | 79.0 |
| 1,2,3,6,7,8-HxCDD | 0.000353 | 6.69E+04 | 6.92 | 0.0346 | 7.23E-03 | 2.20E-06 | 2.20E-05 | 3286.1 | 328.6 |
| 1,2,3,7,8,9-HxCDD | 0.0001734 | 6.69E+04 | 6.92 | 0.0170 | 3.55E-03 | 2.20E-06 | 2.20E-05 | 1614.2 | 161.4 |
| 1,2,3,4,6,7,8-HpCDF | 0.000357 | 5.52E+04 | 6.64 | 0.0242 | 5.05E-03 | 2.20E-05 | 2.20E-04 | 229.6 | 23.0 |
| 1,2,3,4,7,8,9-HpCDF | 0.0000394 | 4.80E+04 | 6.53 | 0.0025 | 5.15E-04 | 2.20E-05 | 2.20E-04 | 23.4 | 2.3 |
| 1,2,3,4,6,7,8-HpCDD | 0.002413333 | 6.77E+04 | 6.80 | 0.1835 | 3.84E-02 | 2.20E-05 | 2.20E-04 | 1744.3 | 174.4 |
| OCDF | 0.000335667 | 6.71E+05 | 8.60 | 0.0949 | 1.98E-02 | 1.54E-03 | 1.54E-02 | 12.9 | 1.3 |
| OCDD | 0.0157 | 4.03E+05 | 8.20 | 3.3158 | 6.93E-01 | 1.54E-03 | 1.54E-02 | 450.1 | 45.0 |
| Dioxin/Furan TEQ | Sum of congener TQs | | | | | | | 44252.9 | 4425.3 |

Notes:
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.
Koc = organic carbon normalized soil-water partition coefficient for organic compounds
Kow = octanol-water partition coefficient

## TABLE 4-18 Exposure Calculation and Comparison to EBVs for Long-tailed Weasel - Mercury, All Exposure Units

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Long-tailed Weasel **AUF:** EU-specific

**Toxicity quotient calculations**

| Analyte | Exposure Unit | EPC | | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|
| | | (mg/kg) | Basis | | | NOAEL | LOAEL | NOAEL | LOAEL |
| Mercury (elemental) | West Parcel Upland EU | NA | 90UCL - Composite samples | NA | NA | 1.0 | 5.0 | NA | NA |
| | | nc | 90UCL - Discrete samples | NA | NA | | | NA | NA |
| | | 3.5 | MDC | 0.023 | 0.0025 | | | 0.002 | 0.0005 |
| | Central Parcel Upland EU | 3.23 | 90UCL - Composite samples | 0.047 | 0.0046 | | | 0.005 | 0.001 |
| | | 3.84 | 90UCL - Discrete samples | 0.047 | 0.0055 | | | 0.006 | 0.001 |
| | East Parcel Upland EU | 0.116 | 90UCL - Composite samples | 0.035 | 0.0001 | | | 0.0001 | 0.00002 |
| | | 0.222 | 90UCL - Discrete samples | 0.035 | 0.0002 | | | 0.0002 | 0.00005 |
| | Central Beach EU | nc | 90UCL - Composite samples | NA | NA | | | NA | NA |
| | | nc | 90UCL - Discrete samples | NA | NA | | | NA | NA |
| | | 1.18 | MDC | 0.0020 | 0.0001 | | | 0.0001 | 0.00001 |
| | Inner Cove Beach EU | nc | 90UCL - Composite samples | NA | NA | | | NA | NA |
| | | 26.04 | 90UCL - Discrete samples | 0.0067 | 0.0053 | | | 0.01 | 0.001 |

Notes:
AUF = Area Use Factor
Ce = concentration in earthworm
Cm = concentration in small mammals
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
mg/kg dw = milligram per kilogram dry weight
NA = Not Applicable
nc = not calculated; 90UCL was not calculated if there were too few samples for proUCL to calculate a 90UCL.
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.
90UCL calculations provided where available; if not able to calculate, then MDC is provided.

## TABLE 4-19 Exposure Calculation and Comparison to EBVs for Long-tailed Weasel - Aroclors, All Exposure Units

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Long-tailed Weasel

**AUF:** EU-specific

**Toxicity quotient calculations**

| Analyte | Exposure Unit | EPC | | Koc (L/kg) | LogKow | Ce (mg/kg dw) | Cm (mg/kg dw) | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (mg/kg) | Basis | | | | | | | NOAEL | LOAEL | NOAEL | LOAEL |
| Total Aroclors | West Parcel Upland EU | NA | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | nc | 90UCL - Discrete samples | NA | | Not Applicable | | | | | | | |
| | | 0.111 | MDC | NA | | 0.2 | 0.2 | 0.023 | 0.00063 | 0.0037 | 0.037 | 0.17 | 0.017 |
| | Central Parcel Upland EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 0.163 | 90UCL - Discrete samples | NA | | 0.3 | 0.3 | 0.047 | 0.0022 | 0.0037 | 0.037 | 0.6 | 0.06 |
| | East Parcel Upland EU | 5.22 | 90UCL - Composite samples | NA | | 38.8 | 38.8 | 0.035 | 0.1777 | 0.0037 | 0.037 | 48.0 | 4.8 |
| | | 0.445 | 90UCL - Discrete samples | NA | | 1.4 | 1.4 | 0.035 | 0.0063 | 0.0037 | 0.037 | 1.7 | 0.2 |
| | Central Beach EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | Inner Cove Beach EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 168.2 | 90UCL - Discrete samples | NA | | 4382.3 | 4382.3 | 0.0067 | 3.82 | 0.0037 | 0.037 | 1033.3 | 103.3 |
| Aroclor 1254 | West Parcel Upland EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | Central Parcel Upland EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | East Parcel Upland EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 0.0208 | 90UCL - Discrete samples | 130500 | 6.5 | 0.5 | 0.5 | 0.035 | 0.002 | 0.0037 | 0.037 | 0.6 | 0.06 |
| | Central Beach EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | Inner Cove Beach EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 168.2 | 90UCL - Discrete samples | 130500 | 6.5 | 3640.0 | 3640.0 | 0.0067 | 3.18 | 0.0037 | 0.037 | 858.6 | 85.9 |
| Aroclor 1260 | West Parcel Upland EU | NA | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | nc | 90UCL - Discrete samples | NA | | Not Applicable | | | | | | | |
| | | 0.111 | MDC | 349700 | 7.55 | 7.3 | 7.3 | 0.023 | 0.02198 | 0.0037 | 0.037 | 5.9 | 0.59 |
| | Central Parcel Upland EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 0.159 | 90UCL - Discrete samples | 349700 | 7.55 | 10.5 | 10.5 | 0.047 | 0.06433 | 0.0037 | 0.037 | 17.4 | 1.7 |
| | East Parcel Upland EU | nc | 90UCL - Composite samples | NA | | Not Applicable | | | | | | | |
| | | 0.441 | 90UCL - Discrete samples | 349700 | 7.55 | 29.2 | 29.2 | 0.035 | 0.13287 | 0.0037 | 0.037 | 35.9 | 3.6 |
| | Central Beach EU | Not Detected | | NA | | Not Applicable | | | | | | | |
| | Inner Cove Beach EU | Not Detected | | NA | | Not Applicable | | | | | | | |

Notes:
AUF = Area Use Factor
Ce = concentration in earthworm
Cm = concentration in small mammals
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
mg/kg dw = milligram per kilogram dry weight
NA = Not Applicable
nc = not calculated; 90UCL was not calculated if there were too few samples for proUCL to calculate a 90UCL.
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.
90UCL calculations provided where available; if not able to calculate, then MDC is provided.

## TABLE 4-20 Exposure Calculation and Comparison to EBVs for Long-tailed Weasel - Pesticides, All Exposure Units

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Long-tailed Weasel **AUF:** EU-specific

**Toxicity quotient calculations**

| Analyte | Exposure Unit | EPC | | Koc (L/kg) | LogKow | Ce (mg/kg dw) | Cm (mg/kg dw) | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) | | Toxicity Quotient (TQ) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (mg/kg) | Basis | | | | | | | NOAEL | LOAEL | NOAEL | LOAEL |
| Total of 4,4'-DDD, -DDE, -DDT | Central Beach EU | 0.00123 | MDC | NA | NA | 0.0138 | 0.1 | 0.002 | 1.73E-05 | 0.147 | 0.735 | 1.18E-04 | 2.36E-05 |
| | East Parcel Upland EU | 0.0571 | MDC | NA | NA | 0.6395 | 3.1 | 0.035 | 1.41E-02 | 0.147 | 0.735 | 9.57E-02 | 1.91E-02 |
| Total of 2,4' and 4,4'-DDD, -DDE, -DDT | Central Beach EU | 0.0016 | MDC | NA | NA | 0.0179 | 0.1 | 0.002 | 2.25E-05 | 0.147 | 0.735 | 1.53E-04 | 3.06E-05 |
| beta-Endosulfan | Central Beach EU | 0.000726 | MDC | 6761.0 | 3.5 | 0.00074 | 0.0007 | 0.002 | 2.02E-07 | 0.150 | NA | 1.34E-06 | NA |
| beta-Hexachlorocyclohexane | Central Beach EU | 0.000831 | MDC | 2807.0 | 4.3 | 0.00941 | 0.0094 | 0.002 | 2.46E-06 | 1.600 | 3.200 | 1.53E-06 | 7.67E-07 |
| Endrin | Central Beach EU | 0.000751 | MDC | 20090.0 | 5.5 | 0.01288 | 0.0129 | 0.002 | 3.36E-06 | 0.092 | 0.920 | 3.65E-05 | 3.65E-06 |
| Total Endosulfan | Central Beach EU | 0.000726 | MDC | 6761.0 | 3.5 | 0.00074 | 0.0007 | 0.002 | 2.02E-07 | 0.150 | NA | 1.34E-06 | NA |

Notes:

Only MDCs are provided because there were too few data to calculate 90UCLs.

AUF = Area Use Factor
Ce = concentration in earthworm
Cm = concentration in small mammals
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
mg/kg dw = milligram per kilogram dry weight
NA = Not Applicable
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations

## TABLE 4-21 Exposure Calculation and Comparison to EBVs for Long-tailed Weasel - Dioxins/Furans, Wharf Road Exposure Unit

### Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

**Modeled Receptor:** Long-tailed Weasel **AUF:** EU-specific (Wharf Road EU)

**Toxicity quotient calculations - based on MDC of incremental samples**

| Analyte | EPC-MDC (mg/kg) | Koc | LogKow | Ce (mg/kg dw) | Cm (mg/kg dw) | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) NOAEL | EBV (mg/kg BW/day) LOAEL | Toxicity Quotient (TQ) NOAEL | Toxicity Quotient (TQ) LOAEL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,3,7,8-TCDF | 3.73E-05 | 2.8E+05 | 7.92 | NA | 0.000005 | 0.0016 | 1.30E-09 | 2.20E-06 | 2.20E-05 | 5.93E-04 | 5.93E-05 |
| 2,3,7,8-TCDD | 6.45E-06 | 2.8E+05 | 7.92 | NA | 0.000005 | 0.0016 | 1.05E-09 | 2.20E-07 | 2.20E-06 | 4.77E-03 | 4.77E-04 |
| 1,2,3,7,8-PeCDF | 4.56E-05 | 3.1E+05 | 8.20 | 0.012 | 0.012 | 0.0016 | 2.58E-06 | 1.54E-05 | 1.54E-04 | 1.68E-01 | 1.68E-02 |
| 2,3,4,7,8-PeCDF | 1.59E-03 | 2.8E+05 | 7.92 | 0.274 | 0.274 | 0.0016 | 5.70E-05 | 1.54E-06 | 1.54E-05 | 3.70E+01 | 3.70E+00 |
| 1,2,3,7,8-PeCDD | 8.48E-05 | 2.8E+05 | 7.92 | 0.015 | 0.015 | 0.0016 | 3.04E-06 | 2.20E-07 | 2.20E-06 | 1.38E+01 | 1.38E+00 |
| 1,2,3,4,7,8-HxCDF | 2.55E-04 | 1.8E+05 | 7.58 | 0.034 | 0.034 | 0.0016 | 7.13E-06 | 2.20E-06 | 2.20E-05 | 3.24E+00 | 3.24E-01 |
| 1,2,3,6,7,8-HxCDF | 2.80E-04 | 2.8E+05 | 7.92 | 0.048 | 0.048 | 0.0016 | 1.00E-05 | 2.20E-06 | 2.20E-05 | 4.56E+00 | 4.56E-01 |
| 2,3,4,6,7,8-HxCDF | 6.52E-04 | 2.4E+05 | 7.80 | 0.103 | 0.103 | 0.0016 | 2.14E-05 | 2.20E-06 | 2.20E-05 | 9.73E+00 | 9.73E-01 |
| 1,2,3,4,7,8-HxCDD | 5.30E-05 | 4.1E+05 | 8.21 | 0.011 | 0.011 | 0.0016 | 2.35E-06 | 2.20E-06 | 2.20E-05 | 1.40E-03 | 1.07E-01 |
| 1,2,3,6,7,8-HxCDD | 6.59E-04 | 6.7E+04 | 6.92 | 0.065 | 0.065 | 0.0016 | 1.34E-05 | 2.20E-06 | 2.20E-05 | 1.40E-03 | 6.11E-01 |
| 1,2,3,7,8,9-HxCDD | 3.33E-04 | 6.7E+04 | 6.92 | 0.033 | 0.033 | 0.0016 | 6.79E-06 | 2.20E-06 | 2.20E-05 | 1.40E-03 | 3.09E-01 |
| 1,2,3,4,6,7,8-HpCDF | 4.49E-04 | 5.5E+04 | 6.64 | 0.030 | 0.030 | 0.0016 | 6.32E-06 | 2.20E-05 | 2.20E-04 | 1.40E-02 | 2.87E-02 |
| 1,2,3,4,7,8,9-HpCDF | 7.38E-05 | 4.8E+04 | 6.53 | 0.005 | 0.005 | 0.0016 | 9.59E-07 | 2.20E-05 | 2.20E-04 | 1.40E-02 | 4.36E-03 |
| 1,2,3,4,6,7,8-HpCDD | 3.16E-03 | 6.8E+04 | 6.80 | 0.240 | 0.240 | 0.0016 | 5.00E-05 | 2.20E-05 | 2.20E-04 | 1.40E-02 | 2.27E-01 |
| OCDF | 3.66E-04 | 6.7E+05 | 8.60 | 0.104 | 0.104 | 0.0016 | 2.15E-05 | 1.54E-03 | 1.54E-02 | 9.80E-01 | 1.40E-03 |
| OCDD | 1.88E-02 | 4.0E+05 | 8.20 | 3.970 | 3.970 | 0.0016 | 8.26E-04 | 1.54E-03 | 1.54E-02 | 9.80E-01 | 5.36E-02 |
| Dioxin/Furan TEQ | | | | | | | | Sum of congener TQs | | 7.05E+01 | 8.19E+00 |

**Toxicity quotient calculations - based on Average of incremental samples**

| Analyte | EPC-Avg (mg/kg) | Koc (L/kg) | LogKow | Ce (mg/kg dw) | Cm (mg/kg dw) | AUF | Exposure Estimate (mg/kg BW/ day) | EBV (mg/kg BW/day) NOAEL | EBV (mg/kg BW/day) LOAEL | Toxicity Quotient (TQ) NOAEL | Toxicity Quotient (TQ) LOAEL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,3,7,8-TCDF | 2.23E-05 | 2.8E+05 | 7.92 | NA | 0.000003 | 0.0016 | 7.80E-10 | 2.20E-06 | 2.20E-05 | 3.54E-04 | 3.54E-05 |
| 2,3,7,8-TCDD | 5.11E-06 | 2.8E+05 | 7.92 | NA | 0.000004 | 0.0016 | 8.15E-10 | 2.20E-07 | 2.20E-06 | 3.70E-03 | 3.70E-04 |
| 1,2,3,7,8-PeCDF | 2.65E-05 | 3.1E+05 | 8.20 | 0.007 | 0.007 | 0.0016 | 1.50E-06 | 1.54E-05 | 1.54E-04 | 9.75E-02 | 9.75E-03 |
| 2,3,4,7,8-PeCDF | 7.24E-04 | 2.8E+05 | 7.92 | 0.125 | 0.125 | 0.0016 | 2.59E-05 | 1.54E-06 | 1.54E-05 | 1.68E+01 | 1.68E+00 |
| 1,2,3,7,8-PeCDD | 5.79E-05 | 2.8E+05 | 7.92 | 0.010 | 0.010 | 0.0016 | 2.07E-06 | 2.20E-07 | 2.20E-06 | 9.43E+00 | 9.43E-01 |
| 1,2,3,4,7,8-HxCDF | 1.18E-04 | 1.8E+05 | 7.58 | 0.016 | 0.016 | 0.0016 | 3.29E-06 | 2.20E-06 | 2.20E-05 | 1.50E+00 | 1.50E-01 |
| 1,2,3,6,7,8-HxCDF | 1.35E-04 | 2.8E+05 | 7.92 | 0.023 | 0.023 | 0.0016 | 4.83E-06 | 2.20E-06 | 2.20E-05 | 2.19E+00 | 2.19E-01 |
| 2,3,4,6,7,8-HxCDF | 3.13E-04 | 2.4E+05 | 7.80 | 0.049 | 0.049 | 0.0016 | 1.03E-05 | 2.20E-06 | 2.20E-05 | 4.67E+00 | 4.67E-01 |
| 1,2,3,4,7,8-HxCDD | 3.91E-05 | 4.1E+05 | 8.21 | 0.008 | 0.008 | 0.0016 | 1.73E-06 | 2.20E-06 | 2.20E-05 | 1.40E-03 | 7.86E-02 |
| 1,2,3,6,7,8-HxCDD | 3.53E-04 | 6.7E+04 | 6.92 | 0.035 | 0.035 | 0.0016 | 7.20E-06 | 2.20E-06 | 2.20E-05 | 1.40E-03 | 3.27E-01 |
| 1,2,3,7,8,9-HxCDD | 1.73E-04 | 6.7E+04 | 6.92 | 0.017 | 0.017 | 0.0012 | 2.65E-06 | 2.20E-06 | 2.20E-05 | 1.40E-03 | 1.21E-01 |
| 1,2,3,4,6,7,8-HpCDF | 3.57E-04 | 5.5E+04 | 6.64 | 0.024 | 0.024 | 0.0016 | 5.03E-06 | 2.20E-05 | 2.20E-04 | 1.40E-02 | 2.29E-02 |
| 1,2,3,4,7,8,9-HpCDF | 3.94E-05 | 4.8E+04 | 6.53 | 0.002 | 0.002 | 0.0016 | 5.12E-07 | 2.20E-05 | 2.20E-04 | 1.40E-02 | 2.33E-03 |
| 1,2,3,4,6,7,8-HpCDD | 2.41E-03 | 6.8E+04 | 6.80 | 0.184 | 0.184 | 0.0016 | 3.82E-05 | 2.20E-05 | 2.20E-04 | 1.40E-02 | 1.74E-01 |
| OCDF | 3.36E-04 | 6.7E+05 | 8.60 | 0.095 | 0.095 | 0.0016 | 1.97E-05 | 1.54E-03 | 1.54E-02 | 9.80E-01 | 1.28E-03 |
| OCDD | 1.57E-02 | 4.0E+05 | 8.20 | 3.316 | 3.316 | 0.0016 | 6.90E-04 | 1.54E-03 | 1.54E-02 | 9.80E-01 | 4.48E-02 |
| Dioxin/Furan TEQ | | | | | | | | Sum of congener TQs | | 3.67E+01 | 4.25E+00 |

Notes:
AUF = Area Use Factor
Ce = concentration in earthworm
Cm = concentration in small mammals
CPEC - Chemical of Potential Ecological Concern
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
mg/kg dw = milligram per kilogram dry weigh
NA = Not Applicable
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit on the mean
Refer to Section 3 tables for all exposure parameters, EBVs, and equations.

# TABLE 4-22 Generic High Concentration Hot Spot Values for Ecological Receptors

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

| CAS Number | CPEC | Plants Oregon DEQ-Approved Level II SLVs (mg/kg)[1] | Invertebrates Oregon DEQ-Approved Level II SLVs (mg/kg)[1] | Birds Oregon DEQ-Approved Level II SLVs (mg/kg)[1] | Mammals Oregon DEQ-Approved Level II SLVs (mg/kg)[1] | Lowest Level II SLV mg/Kg[1] | | T&E Hot Spot | Basis for SLV | Proposed Hot Spot Values mg/Kg[2] | Natural Background Soil Concs (mg/kg) | Hot Spot Values mg/Kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67562-39-4 | 1,2,3,4,6,7,8-Heptachlorodibenzofuran[a] | NA | NA | 0.000603 | 0.000064 | 0.000064 | Mammals | 0.00064 | LOAEL | 0.00064 | NA | 0.00064 |
| 35822-46-9 | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[a] | NA | NA | 0.0061594 | 0.0000654 | 0.0000654 | Mammals | 0.000654 | LOAEL | 0.000654 | NA | 0.000654 |
| 70648-26-9 | 1,2,3,4,7,8-Hexachlorodibenzofuran[a] | NA | NA | 0.0000361 | 0.0000038 | 0.0000038 | Mammals | 0.000038 | LOAEL | 0.000038 | NA | 0.000038 |
| 57117-44-9 | 1,2,3,6,7,8-Hexachlorodibenzofuran[a] | NA | NA | 0.0000361 | 0.0000038 | 0.0000038 | Mammals | 0.000038 | LOAEL | 0.000038 | NA | 0.000038 |
| 57653-85-7 | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin[a] | NA | NA | 0.0003614 | 0.0000038 | 0.0000038 | Mammals | 0.000038 | LOAEL | 0.000038 | NA | 0.000038 |
| 19408-74-3 | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[a] | NA | NA | 0.0000361 | 0.0000038 | 0.0000038 | Mammals | 0.000038 | LOAEL | 0.000038 | NA | 0.000038 |
| 40321-76-4 | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin[a] | NA | NA | 0.0000994 | 0.0000109 | 0.0000109 | Mammals | 0.000109 | LOAEL | 0.000109 | NA | 0.000109 |
| 60851-34-5 | 2,3,4,6,7,8-Hexachlorodibenzofuran[a] | NA | NA | 0.0000361 | 0.0000038 | 0.0000038 | Mammals | | LOAEL | 0.000038 | NA | 0.000038 |
| 57117-31-4 | 2,3,4,7,8-Pentachlorodibenzofuran[a] | NA | NA | 0.000016 | 0.0000057 | 0.0000057 | Mammals | | LOAEL | 0.000057 | NA | 0.000057 |
| 7440-36-0 | Antimony | 5 | 78 | NA | 0.27 | 0.27 | Mammals | | NOAEL | 13.5 | 0.56 | 13.5 |
| 12767-79-2 | Total PCBs (Total Aroclors[b,c]) | 40 | NA | 0.655 | 0.371 | 0.371 | Mammals | | LOAEL | 3.71 | NA | 3.71 |
| 7440-39-3 | Barium | 500 | 330 | 85 | 2000 | 85 | Birds | | NOAEL | 4250 | 790 | 4250 |
| 7440-43-9 | Cadmium | 32 | 140 | 0.77 | 0.36 | 0.36 | Mammals | | LOEC | 3.6 | 0.63 | 3.6 |
| 7440-47-3 | Chromium[d] | 1 | 0.4 | 26 | 34 | 26 | Birds | | NOAEL | 260 | 76 | 260 |
| 7440-50-8 | Copper | 70 | 80 | 28 | 49 | 28 | Birds | | NOAEL | 1400 | 34 | 1400 |
| 132-64-9 | Dibenzofuran | NA | NA | NA | 0.002 | 0.002 | Mammals | | NOAEL | 0.1 | NA | 0.1 |
| TEQ_DIOXIN.0 | Total TCDD toxicity equivalent[a] | NA | NA | 0.0000217 | 0.0000023 | 0.0000023 | Mammals | | LOAEL | 0.000023 | NA | 0.000023 |
| DRH | Diesel Range Hydrocarbons | NA | 200 | 6000 | 6000 | 200 | Invertebrates | | ? | 2000 | NA | 2000 |
| HPAH | High Molecular Weight PAH | NA | 18 | NA | 1.1 | 1.1 | Mammals | 11 | NOAEL | 55 | NA | 55 |
| 7439-92-1 | Lead | 120 | 1700 | 11 | 56 | 11 | Birds | | NOAEL | 550 | 79 | 550 |
| 7439-97-6 | Mercury | 0.3 | 0.1 | 1.5 | 73 | 0.1 | Invertebrates | | ? | 1 | 0.23 | 1 |
| 7440-02-0 | Nickel | 38 | 280 | 210 | 130 | 38 | Plants | | LOEC | 380 | 47 | 380 |
| 39001-02-0 | Octachlorodibenzofuran | NA | NA | 0.0259421 | 0.0009169 | 0.0009169 | Mammals | | LOAEL | 0.009169 | NA | 0.0092 |
| 7440-66-6 | Zinc | 160 | 120 | 46 | 79 | 46 | Birds | | NOAEL | 2300 | 180 | 2300 |

Notes:
NOAEL = no-observed-adverse-effects-level
LOAEL = lowest-observed-adverse-effects-level
SLV = screening-level value

[1] Refer to Table 2-1 for screening level and background value source information.

[2] Lowest screening level value from plants, invertebrates, birds, and mammals selected. Values based on NOAEL are 50-times the SLV for high concentration hot spot values; values based on LOAELs are 10-times the SLV for high concentration hot spot values - per July 19, 2013 ODEQ Response to Comments. Exception for chromium, see footnote (d).

--- = not available; proposed hot spot values are below background levels.

a. Values are from DEQ Table 1 and Table 2 as directed in October 7, 2013 Re:Response to DEQ July 19, 2013 Letter, Draft Residual Human Health and Ecological Risk Residual Assessments Willamette Cove Upland Facility:Comment 18c

b. Values are from Preliminary Remediation Goals for Ecological End Points, 1997 as directed in October 7, 2013 Re:Response to DEQ July 19, 2013 Letter, Draft Residual Human Health and Ecological Risk Residual Assessments Willamette Cove Upland Facility:Comment 18b

c. Total PCBs (Total Aroclors) applies to Aroclor 1254 and 1260.

d. The hotspot value for chromium is based on the lowest calculated hotspot value that is also above background concentration.

# Table 5-1 Summary of Chemicals of Concern (COCs) by Exposure Unit

## Willamette Cove Upland Facility - Residual Risk Assessment - Surface Soils

| Chemical | West Parcel Upland EU | East Parcel Upland EU | Central Parcel Upland EU | Inner Cove Beach EU | Central Beach EU | Wharf Road EU |
|---|---|---|---|---|---|---|
| Mercury | P, I | I | P, I | P, I, B (r) | I | |
| Antimony | | P, M (s) | P, M (s) | P, M (s) | | |
| Chromium | | P, I | P, I | | | |
| Copper | | P, I, B (r), M (s) | P, I, B (r), M (s) | P, I, B (r), M (s) | | |
| Lead | | P, B (r), M (s) | P,  B (r) , M (s) | P, I, B (r), M (s) | | |
| Zinc | | P, I, M (s) | P, I, M (s) | I, M (s) | | |
| DRH | | | I | I | | |
| HPAHs | | | I, M (s) | M (s) | | |
| Nickel | | P | | | | |
| Aroclors | | B (r), M (s), M (w) | M (w) | P, B (r), M (s), M (w) | | |
| Aroclor 1254 | | | | P | | |
| Cadmium | | | | | B (r), M (s) | |
| Dioxins/furans | | | | | | B (r ), M (s), M (w) |
| **COC Summary by Receptor** | | | | | | |
| Plant COCs | 1 | 6 | 6 | 6 | 0 | 0 |
| Invertebrate COCs | 1 | 4 | 6 | 6 | 1 | 0 |
| Bird COCs | 0 | 3 | 2 | 4 | 1 | 1 |
| Mammalian COCs | 0 | 5 | 6 | 6 | 1 | 1 |

Notes:

Refer to Tables 2-2 through 2-7 and Table 4-1 for details.

EU = Exposure Unit

P = Plants

I = Invertebrates

B (r) = Bird (American robin)

B (h) = Bird (red-tailed hawk)

M (s) = Mammal (short-tailed shrew)

M (w) = Mammal (long-tailed weasel)

DRH = diesel-range hydrocarbons

HPAH = High molecular weight polynuclear aromatic hydrocarbons